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DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

MINERAL RESOURCES

OF THE

UNITED STATES

1920

G. F. LOUGHLIN
Geologist in Charge, Division of Mineral Resources

PART I—METALS

G. F. LOUGHLIN, Geologist in Charge

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MINERAL RESOURCES OF THE UNITED STATES, 1920—PART I.

MINERAL RESOURCES OF THE UNITED STATES IN 1920.[1]

INTRODUCTION.

By G. F. Loughlin.

Geologist in charge, Division of Mineral Resources.

The year 1920 showed on the whole an improvement over 1919 in the quantity and value of mineral products sold and made a new record in the total value of mineral products ($6,919,500,000), but the conditions of operation remained unfavorable and the marked increase in value was not so much a result of renewed prosperity as of increased costs of operation. The two years presented a contrast in that 1919 began in a period of depression that closely followed the signing of the armistice and continued until autumn, whereas 1920, began in a period of improved demand, except for metals, which also lasted until autumn, when a period of general stagnation began that has continued until the present time (June, 1921).

The temporary increase in activities which characterized the greater part of 1920 was evidently due in part to the tendency of some to continue the wartime habit of purchasing regardless of price and also to overoptimism on the part of producers, especially those of base metals; but markets had become overstocked with many commodities, and ultimate consumers gradually adopted the policy of postponing the purchase of goods they did not urgently need. As a result, the stagnation that was manifest in a few industries in the summer of 1920 had become general by November.

In other words, the law of supply and demand has been following its natural course, to the discomfort of those who have profited by the war but to the gradual relief of many who had not. Attempts of labor organizations to have the high wages of war time continued resulted in several strikes and helped to increase costs of operation, with resulting temporary increase in prices. This was especially true in the coal trades, which in turn affected many other industries. The poor conditions of transportation that were characteristic of 1919 continued well into 1920 and increased the uncertainties and consequently the cost of operation. These disturbances, however, have gradually spent themselves, prices have been falling, and efforts to repeal excessive war-time taxes and lower transportation rates are helping to bring industrial conditions back to normal. Some pre-

[1] It was intended to publish historical tables of mineral production from 1880–1920 in this summary, but owing to the shortage of funds, the publication has been postponed. Tables showing production for 1880–1915 are given in Mineral Resources, 1915, Part I, pp. 31a–53a.

All figures of imports and exports in this summary were compiled by J. A. Dorsey, of the Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce, having been converted by Mr. Dorsey to the various units of measurement used in this report and arranged by him in their present form. The imports are those for the calendar year unless otherwise stated. Wherever exports are shown, unless otherwise specified, the figures represent domestic products and not foreign minerals reexported, and they also cover calendar years.

dictions are made that prices are to rise during the spring and summer of 1921, but no marked or permanent rises are to be expected until normal conditions are again attained.

Of the leading mineral commodities, the mineral fuels, especially bituminous coal, are among the best indicators of the trend of industry. The production of bituminous coal made a rapid recovery from the great strike of November, 1919. It declined again during the severe storms of February but was running well up to normal when the outlaw switchmen's strike broke on April 1. The resulting congestion of the railroads prevented the reaccumulation of consumers' stocks, which had been nearly exhausted by the miners' strike, and as soon as the Government maximum prices were withdrawn the spot price began to rise, ultimately reaching the highest levels ever recorded. Contributing to the high prices was unprecedented export demand. From the middle of April there was a general increase in the rate of production until the middle of December, when a record daily production was attained. The year's output, 568,213,000 short tons, approached that of the record year, 1918. In December the general depression influenced the output, and a rapid decline set in that continued into April, 1921, when the average daily production was only slightly more than 1,000,000 short tons—about half the capacity of the mines and transportation facilities.

This decline was more continuous than in 1918–19, when similar conditions, an industrial depression and a mild winter, limited the demand. Consumers' stocks had accumulated during the last half of 1920, and on January 1, 1921, they were comfortably large, though far below those of January 1, 1919. Up to April 1, 1921, stocks had not been lowered to the danger point but were still being depleted. Production, however, began to increase during the last half of April, owing partly to an increased export demand following the British miners' strike.

Anthracite coal was produced for a while at a faster rate than in 1919, but production was interrupted by labor troubles, and the calendar year 1920 closed with production only about 1,000,000 short tons above that of 1919, and about 10,000,000 tons below that of each of the two preceding years.

There was no marked saving of coal through the development of hydroelectric power in 1920, but plans formulated by the Federal Power Commission and the superpower survey may begin soon to show results in this direction, and attention directed to the more efficient transportation and utilization of coal[2] may also result in diminishing the rate of depletion of our most accessible reserve of coal, in spite of a renewed normal growth of industry.

The steady substitution of by-product for beehive coke which has marked recent years continued through 1920. Of the total production of coke, 51,345,000 tons, 40 per cent was made in beehive ovens and 60 per cent in by-product ovens. About 760 new by-product ovens were put into operation during the year, and about 400 more were under construction at the end of the year.

The petroleum industry was marked by a steady increase in production from January to November, 1920, followed by a decline for

[2] Smith, G. O., and Tryon, F. G., Fluctuations in coal production—their extent and causes; Mining and Metallurgy, No. 159, sec. 3, pp. 9–28, March, 1920. Smith, G. O., Thrift in coal; address delivered before the American Iron and Steel Institute, New York, Oct. 22, 1920.

two months. There was a small increase in February, 1921, and the production in March was the greatest monthly output recorded. The domestic consumption of petroleum so greatly exceeds the domestic production that the decline would not be expected to be as marked as that of coal. The consumption increased markedly during 1920, especially between July and October, after which it began to fluctuate, with a net decline that became pronounced in February, 1921. Consumption exceeded production and imports until May, 1920, but imports more than doubled during the year and together with increased production replenished reserve stocks whose gradual depletion had for some time been a cause of grave concern. The price of all grades of petroleum reached a maximum early in 1920 and remained at the high level until January, 1921. Decrease in consumption and increase in stocks, however, finally resulted in a precipitous decrease in price, and by February, 1921, prices had declined to 50 per cent of the previous high. It is generally agreed that present methods of production fall far short of extracting all the oil in our pools, and attention is being directed to greater efficiency, which will result in prolonging the life of oil fields beyond existing estimates. Productive areas are being extended, but our consumption is still far in excess of our production.

The metal-mining industry continued far below normal, although there were some temporary improvements compared with 1919. Gold mining continued in a greatly depressed condition, and the value of the country's output decreased to about $51,000,000. Production decreased in all Western States except Arizona, where gold is obtained partly as a by-product of copper and lead ores, both of which increased in that State in 1920. Less than half the gold mines of the country were active, and some large mines were closed permanently. Placer mining also was curtailed, not only because of excessive cost of operation but because of shortage of water and hydroelectric power in California and Oregon and of local mishaps in certain other States.

The small domestic production of platinum and allied metals, largely a by-product of placer gold mining, increased, whereas the total production of refined platinum decreased. Other metals in the group showed small to moderate increases.

The production of silver was favored during the first five months of the year by a strong foreign demand and high prices and later by the Pittman Act, which guaranteed a price of nearly $1 an ounce to producers of new domestic silver after the price of silver from other sources had declined to pre-war levels. The output was 2 per cent less than that of 1919, and the value declined 4 per cent, owing to a drop of 2.26 cents an ounce in the average price for the year. Miners of silver ore were especially favored, and a few mines that had been idle since the demonetization of silver were reopened. The price of silver also aided in maintaining the production of ores of lead until late in the year, when the prices of all these metals declined to extremely low levels. Up to the end of 1920 the Government had purchased about 30,000,000 of the 208,000,000 ounces authorized by the Pittman Act.

The total production of copper decreased in 1920, although production in two of the leading Western States increased. Disposal of surplus stocks by some smelters early in the year and premature

expectation of revived foreign trade encouraged large production. The apparent domestic consumption increased slightly, but less than had been expected, whereas the large total stocks of refined copper increased 28,000,000 pounds, and foreign markets were still oversupplied with new and old copper. The resulting poor demand, especially during the last half of the year, together with labor troubles, high operating costs, and the low rates of foreign exchange, caused a great curtailment of production during the last three months of the year. There is no immediate hope of recovery in the demand for copper, and by May, 1921, most of the mines had been closed. The average price of copper for 1920 was about the same as for 1919, but by the end of 1920 quoted prices had reached pre-war levels.

Lead increased in output in 1920, but did not equal the output of 1918. The recoverable zinc content of ores mined in 1920 was also greater than that in 1919, though less than that in 1918. The smelter production of primary zinc from domestic ores, however, was a little less in 1920 than in 1919. Both lead and zinc were favored by higher average prices in 1920 than in 1919, but their prices declined rapidly toward the end of the year, when imports, favored by the low rates of foreign exchange, increased considerably. The low prices of lead and zinc at the end of 1920 caused great curtailment in production.

Iron ore and pig iron underwent fluctuations similar to those in copper, lead, and zinc. The effects of the steel strike in 1919 caused a shortage of material that was made up during the first part of 1920, whereas the general depression during the last half of the year was accompanied by declines in production and price which have persisted well into 1921. Demand in the first six months of 1920 was sufficient to increase the total production of the year, in spite of strikes by ore handlers at the shipping docks and by railroad switchmen, as well as the shortage of fuel, cars, and vessels which preceded the business depression.

The increased demand for iron and steel during the first half of 1920 caused a corresponding demand for manganese, and both domestic production and imports increased markedly. Continued high prices and depleted reserves favored those best equipped to produce domestic manganese. In contrast to manganese, tungsten, chiefly used for making high-speed tools for steel cutting, was in little demand, and domestic production was the smallest since 1902; nevertheless imports were large for peace times, in anticipation of a heavy duty, and accumulated stocks may now exceed a three years' supply at the average rate of consumption. The production of domestic chromite, also affected by large stocks and by inability to compete with imports under normal conditions, underwent a further decrease. Only one molybdenum mine was operated during the year. The production of nickel in Canada underwent fluctuations similar to those in copper and iron. The decline in the small quantity produced in the United States is of little significance. The production of titanium ore (rutile) more than doubled in quantity and uranium and vanadium minerals, used to some extent in the steel industry but chiefly valuable because of their radium content, increased nearly 50 per cent in value.

The production of bauxite for all uses increased nearly 40 per cent in quantity and nearly 50 per cent in value, and the value of alumi-

num manufactured also increased. Imports of aluminum also made a large increase. Continued growth of the aluminum industry as soon as industry revives is expected.

With but few exceptions nonmetallic products other than fuels increased in production. Of those used directly or indirectly as fertilizers, phosphate rock made the greatest gains. The production of phosphate rock surpassed the previous record of 1913, and noteworthy features of the industry were the resumption of large exports and the marked increase in output of the Western States. Sales of domestic potash decreased 9 per cent in quantity and 34 per cent in value, whereas imports in large quantity were resumed. The low price of farm produce and the resulting financial embarrassment to farmers curtailed the demand for potash and so greatly lowered the price that by the end of 1920 all the plants in Nebraska, the chief producing State, were closed. Production in Nebraska and Utah was further hindered by the unusually great rainfall. The outlook thus far in 1921 is discouraging. The quantity of lime and pulverized limestone sold for direct application to the soil was slightly less in 1920 than in 1919. The peat sold for agricultural use made a small increase in quantity and a considerable increase in value.

All architectural and construction materials showed considerable increases in quantity sold in 1920. The quantity and value of Portland cement and gypsum sold surpassed previous records, as did the value of most of the other materials. Conditions in the building industries were similar to general industrial conditions—good until fall, when there was a rapid decline, owing to a decrease in factory building while wages and costs of materials continued high. Prices began to decline early in 1921, and as the shortage of buildings, especially residences, continues, some improvement in demand is noticeable locally. Plans for road building forecast a good demand for cement, crushed stone, sand, and gravel, but steady or rapid advance in construction materials as a whole can not be hoped for until general industrial conditions improve.

Among materials produced mainly for chemical manufacturing industries sulphur showed a remarkable increase in shipments, displacing a considerable proportion of both domestic and Spanish pyrites as raw material for the manufacture of sulphuric acid. Salt, from which a number of sodium compounds are made, decreased slightly, and borates increased 82 per cent in quantity. Lime sold to chemical manufacturing industries also increased. Bromine was the only commodity in this group to show a marked decrease. No data are at hand to show to what extent these raw materials are being affected in 1921 by the general depression.

The ceramic and refractory materials increased, so far as available information shows. Among the abrasives, diatomaceous earth and tripoli, garnet, grindstones and pulpstones, and pumice increased; and emery, millstones, and oilstones decreased. Fluorspar, owing to the renewed activity of the steel industry, and fuller's earth, used mainly in oil refining, also increased, as did asbestos and talc. The mica industry, which on account of the many uses of mica, especially in electrical apparatus, should fluctuate with industry in general, was prosperous until late in 1920, scrap mica increasing 76 per cent in quantity and 188 per cent in value and sheet mica increasing 9 per cent in quantity and 13 per cent in value.

SUMMARY.

By Martha B. Clark.

GENERAL TABLES.

Mineral products of the United States in 1919 and 1920.[a]

Product.	1919		1920		Percentage of increase or decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
METALLIC.						
Aluminum.....pounds..	.....	$38,558,000	.....	$41,375,000	.....	+ 7
Antimonial lead[b].....short tons (2,000 pounds)..	13,874	1,513,968	12,535	1,963,255	− 10	+30
Antimony[c].....do....	2,501	c 410,164	2,785	c 473,450	+ 11	+15
Bauxite.....long tons (2,240 pounds)..	376,566	2,201,747	521,308	3,247,345	+ 38	+47
Cadmium.....pounds..	99,939	121,926	129,283	151,261	+ 29	+24
Chromite.....long tons..	5,079	129,302	2,502	44,857	− 51	−65
Copper[d], sales value.....pounds..	1,286,419,329	239,274,000	1,209,061,040	222,467,000	− 6	− 7
Ferroalloys.....long tons..	e 419,638	e 53,730,964	612,808	77,519,367	+ 46	+44
Gold[f].....troy ounces..	2,918,628	60,333,400	2,476,166	51,186,900	− 15	−15
Iron:						
Ore[g].....long tons..	e 56,372,784	e g 197,312,517	69,281,341	g 285,006,327	+ 23	+44
Pig.....do....	30,130,231	775,915,043	35,710,227	1,140,904,096	+ 19	+47
Lead (refined),[d] sales value.....short tons..	424,433	44,990,000	476,849	76,296,000	+ 12	+70
Manganese ore (35 per cent or more Mn).....long tons..	55,322	1,796,863	94,420	2,396,235	+ 71	+33
Manganiferous ore (5 to 35 per cent Mn).....do....	433,733	1,552,492	767,664	2,437,798	+ 77	+57
Nickel,[h] value at New York City.....short tons..	511	434,485	365	293,250	− 29	−33
Platinum and allied metals (value at New York City).....troy ounces..	45,109	5,614,335	41,544	4,697,722	− 8	−16
Quicksilver (value at San Francisco).....flasks (75 pounds net)..	21,415	1,933,560	13,392	1,066,807	− 37	−45
Silver.....troy ounces..	56,682,445	63,533,652	55,361,573	60,801,955	− 2	− 4
Tin (metallic equivalent).....short tons..	56	73,400	22	22,000	− 61	−70
Titanium ore (rutile).....do....	102	20,400	277	(i)	+172	(i)
Tungsten ore (60 per cent concentrates).....do....	327	353,900	216	101,800	− 34	−71
Uranium and vanadium minerals.....do....	14,509	1,630,900	35,076	2,401,000	+142	+47
Zinc,[d] sales value.....do....	452,272	66,032,000	450,045	72,907,000	− .5	+10
Total value of metallic products (approximate).....	.....	1,359,744,000	.....	1,762,350,000	.....	+30

NONMETALLIC.

Arsenious oxide	short tons	6,029	1,181,684	11,502	2,021,356	+ 91	+ 71
Asbestos	do	[c] 1,161	[c] 248,265	1,648	650,311	+ 42	+162
Asphalt	do	702,973	9,410,361	898,993	13,199,365	+ 28	+ 40
Barytes (crude)	do	209,330	1,727,822	228,113	2,142,464	+ 9	+ 24
Borates	do	66,146	1,380,000	120,320	2,173,000	+ 82	+ 57
Bromine	pounds	1,851,971	1,234,969	1,160,584	745,381	− 37	− 40
Calcium-magnesium chloride	short tons	26,123	321,596	27,849	539,471	+ 7	+ 68
Cement	barrels (376 pounds net)	86,141,488	147,318,398	97,079,200	195,589,915	+ 13	+ 33
Clay:							
Products			[c] 275,346,378		373,670,102		+ 36
Raw [g]	short tons	2,275,100	[g] 7,090,631	3,116,212	[g] 11,614,288	+ 37	+ 64
Coal:							
Bituminous [j]	do	465,860,058	1,160,616,013	568,212,683	2,127,141,000	+ 22	+ 83
Pennsylvania anthracite	long tons	78,653,751	364,926,950	79,998,437	434,252,198	+ 2	+ 19
Coke [g]	short tons	44,180,557	[g] 258,339,740	51,345,043	[g] 494,246,254	+ 16	+ 91
Diatomaceous (infusorial) earth and tripoli	do	66,934	713,501	102,155	1,649,370	+ 53	+131
Emery	do	2,601	23,203	2,327	21,685	− 11	− 7
Feldspar	do	71,054	585,200	151,817	1,508,990	+114	+158
Fluorspar	do	138,290	3,525,574	186,778	4,718,547	+ 35	+ 34
Fuller's earth	do	106,145	1,998,829	128,487	2,506,189	+ 21	+ 25
Garnet for abrasive purposes	do	4,944	310,131	5,476	434,425	+ 11	+ 40
Gems and precious stones			111,763		265,205		+137
Graphite:							
Amorphous	short tons	3,379	47,716	4,694	49,758	+ 39	+ 4
Crystalline	pounds	8,086,191	731,141	9,632,360	576,444	+ 19	− 21
Grindstones and pulpstones	short tons	46,865	1,336,015	53,484	1,707,004	+ 14	+ 28
Gypsum	do	2,420,163	15,727,907	3,129,142	24,533,065	+ 29	+ 56
Lime	do	3,330,347	29,448,553	3,570,141	37,543,840	+ 7	+ 27
Magnesite (crude)	do	156,226	1,248,415	303,767	2,748,150	+ 94	+120
Mica:							
Scrap	do	3,258	58,084	5,723	167,017	+ 76	+188
Sheet	pounds	1,545,709	483,567	1,683,480	546,972	+ 9	+ 13
Millstones			66,972		63,325		− 5
Mineral paints:							
Natural pigments [k]	short tons	(k)	(k)	(k)	(k)	(k)	(k)
Zinc and lead pigments [l]	do	155,648	25,810,671	143,244	24,564,572	− 8	− 5
Mineral waters	gallons sold	38,697,280	4,880,186	36,218,260	4,860,915	− 6	− .4
Natural gas	M cubic feet	739,915,781	132,888,300	[m] 754,336,720	[m] 136,512,500	+ 2	+ 3
Natural-gas gasoline	gallons	351,535,026	64,196,763	384,743,922	71,788,122	+ 9	+ 12
Oilstones, etc	short tons	1,463	235,943	1,144	231,747	− 22	− 2
Peat	do	69,197	705,532	73,204	921,732	+ 6	+ 31

[a] Attention is called to the fact that in this general statement certain of the figures represent shipments rather than quantity mined. The reader is referred to the following sections on the various mineral products for more detailed information in this regard than it seems practicable to give here. [b] From both domestic and foreign ores. [c] From all sources. Values excluded from metallic totals as the values of the antimony contained in antimonial lead are included in the antimonial lead values, and the remainder under last item ("Unspecified"). [d] Product from domestic ores only. [e] Revised figures. [f] Value, $20.671834625323 an ounce. [g] Value not included in total value. [h] By-product in electrolytic copper refining and produced from copper-lead-cobalt-nickel ores. [i] Survey not at liberty to publish figures. Value included in total value of metallic products. [j] Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania. [k] Canvass discontinued after 1915. Value of iron ore sold for paint included under last item ("Unspecified"). [l] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide. [m] Figures preliminary.

Mineral products of the United States in 1919 and 1920—Continued.

Product.		1919		1920		Percentage of increase or decrease.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
NONMETALLIC—continued.							
Petroleum	barrels (42 gallons)	378,367,000	$759,866,000	442,929,000	$1,360,745,000	+ 17	+ 79
Phosphate rock	long tons	2,271,983	11,591,268	4,103,982	25,079,572	+ 81	+116
Potash[1] (K_2O)	short tons	45,728	11,271,269	41,444	7,463,026	− 9	− 34
Pumice	do	36,051	116,835	41,838	114,433	+ 16	− 2
Pyrites	long tons	420,647	2,558,172	310,777	1,596,961	− 26	− 38
Salt	short tons	6,882,902	27,074,694	6,840,029	29,894,075	− 1	+ 10
Sand:							
Glass	do	1,827,409	3,593,371	2,165,926	4,748,690	+ 19	+ 32
Moulding, building, etc., and gravel	do	68,748,998	42,358,185	79,875,462	60,912,915	+ 16	+ 44
Sand-lime brick	thousands	146,947	1,705,163	169,761	2,490,283	+ 16	+ 46
Silica (quartz)	short tons	63,332	373,571	68,190	320,350	+ 8	− 14
Slate		.....	6,030,648	.....	8,726,442	.....	+ 45
Stone	short tons	65,539,000	96,709,143	78,527,000	133,541,960	+ 20	+ 38
Sulphur	long tons	678,257	10,252,000	1,517,625	30,000,000	+124	+193
Sulphuric acid (60° Baumé) from copper and zinc smelters	short tons	[a] 811,509	[a] 7,526,400	[b] 1,229,508	13,617,075	+ 52	+ 81
Talc and soapstone	do	184,843	2,352,675	210,635	3,035,449	+ 14	+ 29
Thorium minerals (monazite)	pounds	[c]	[c]	[c]	[c]	[c]	[c]
Total value of nonmetallic products (approximate)		.....	3,232,226,000	.....	5,152,330,000	.....	+ 59
SUMMARY.							
Total value of metallic products		.....	1,359,744,000	.....	1,762,350,000	.....	+ 30
Total value of nonmetallic products (exclusive of mineral fuels)		.....	749,732,000	.....	1,021,890,000	.....	+ 36
Total value of mineral fuels		.....	2,482,494,000	.....	4,130,440,000	.....	+ 66
Total value of "unspecified" (metallic and nonmetallic) products (partly estimated) [d]		.....	3,400,000	.....	[d] 4,820,000	.....	+ 42
Grand total approximate value of all mineral products		.....	4,595,370,000	.....	6,919,500,000	.....	+ 51

[a] According to the Bureau of the Census. Figures represent production, the value having been partly estimated by Geological Survey to cover acid consumed by producer as well as that sold. [b] Includes 23,728 tons of stronger acid, not converted to 60° Baumé. [c] Value included under last item ("Unspecified"). Survey not at liberty to publish figures. [d] Includes in 1920 products as follows: Antimony other than content of antimonial lead, bismuth, cadmium sulphide ($37,274), chats ($501,000), cobalt ($262,801), columbite ($1,450), flint lining for tube mills, ilmenite, iron ore sold for magnets, iron ore sold for paint ($112,364), lithium minerals ($173,002), magnesium, marls ($326,372), molybdenum ($17,207), monazite, pebbles for grinding ($45,906), selenium ($175,508), silica sand and sandstone, finely ground ($1,183,014), sodium salts (carbonate, bicarbonate, sulphate, and trona) from natural sources ($1,182,697), tellurium, and an estimate of the value of miscellaneous mineral products, statistics for which are not collected annually by the Survey.

Total value of mineral products of the United States from 1880 to 1920.

Year.	Metallic.		Nonmetallic.		Unspecified (metallic and nonmetallic).	Total.	
	Value.	Percentage of increase or decrease.	Value.	Percentage of increase or decrease.		Value.	Percentage of increase or decrease.
1880	$187,881,000	.....	$173,582,000	.....	$6,000,000	$367,463,000	.....
1881	189,413,000	+ 0.8	207,207,000	+ 19	6,500,000	403,120,000	+ 10
1882	215,820,000	+ 14	230,786,000	+ 11	6,500,000	453,106,000	+ 12
1883	197,881,000	− 8	243,680,000	+ 6	6,500,000	448,061,000	− 1
1884	180,284,000	− 9	221,756,000	− 9	5,000,000	407,040,000	− 9
1885	172,218,000	− 4	242,333,000	+ 9	5,000,000	419,551,000	+ 3
1886	204,400,000	+ 19	250,995,000	+ 4	790,000	456,185,000	+ 9
1887	240,791,000	+ 18	294,057,000	+ 17	785,000	535,633,000	+ 17
1888	242,010,000	+ .5	310,889,000	+ 6	900,000	553,799,000	+ 3
1889	250,325,000	+ 3	291,004,000	− 6	997,000	542,326,000	− 2
1890	303,440,000	+ 21	310,995,000	+ 7	994,000	615,429,000	+ 13
1891	280,485,000	− 8	319,364,000	+ 3	1,000,000	600,849,000	− 2
1892	283,715,000	+ 1	337,517,000	+ 6	1,000,000	622,232,000	+ 4
1893	223,154,000	− 21	321,339,000	− 5	1,000,000	545,493,000	− 12
1894	186,835,000	− 16	362,410,000	+ 13	1,000,000	550,245,000	+ .9
1895	248,033,000	+ 33	393,658,000	+ 9	1,000,000	642,691,000	+ 17
1896	252,075,000	+ 2	387,966,000	− 1	1,000,000	641,041,000	− .3
1897	269,934,000	+ 7	380,678,000	− 2	1,000,000	651,612,000	+ 2
1898	308,247,000	+ 14	417,795,000	+ 10	1,000,000	727,042,000	+ 12
1899	483,521,000	+ 57	525,575,000	+ 26	1,000,000	1,010,096,000	+ 39
1900	513,732,000	+ 6	594,204,000	+ 13	1,000,000	1,108,936,000	+ 10
1901	493,314,000	− 4	660,764,000	+ 11	1,000,000	1,155,078,000	+ 4
1902	604,517,000	+ 23	722,434,000	+ 9	1,000,000	1,327,951,000	+ 15
1903	588,753,000	− 3	905,628,000	+ 25	1,000,000	1,495,381,000	+ 13
1904	501,114,000	− 15	857,667,000	− 5	400,000	1,359,181,000	− 9
1905	702,585,000	+ 40	920,780,000	+ 7	400,000	1,623,765,000	+ 19
1906	886,180,000	+ 26	1,014,500,000	+ 10	200,000	1,900,880,000	+ 17
1907	904,108,000	+ 2	1,165,376,000	+ 15	86,000	2,069,570,000	+ 9
1908	550,768,000	− 39	1,040,761,000	− 11	244,000	1,591,773,000	− 23
1909	754,944,000	+ 37	1,131,866,000	+ 9	297,000	1,887,107,000	+ 19
1910	749,879,000	− .7	1,237,668,000	+ 9	297,000	1,987,844,000	+ 5
1911	680,907,000	− 9	1,242,942,000	+ .4	232,000	1,924,081,000	− 3
1912	862,008,000	+ 27	1,375,420,000	+ 11	366,000	2,237,794,000	+ 16
1913	878,869,000	+ 2	1,554,298,000	+ 13	378,000	2,433,545,000	+ 9
1914	686,639,000	− 22	1,424,063,000	− 8	470,000	2,111,172,000	− 13
1915	991,730,000	+ 44	1,400,484,000	− 2	2,430,000	2,394,644,000	+ 13
1916	1,620,745,000	+ 63	1,884,413,000	+ 35	3,281,000	3,508,439,000	+ 47
1917	2,086,234,000	+ 29	2,900,462,000	+ 54	5,800,000	4,992,496,000	+ 42
1918	2,153,318,000	+ 3	3,380,690,000	+ 17	6,700,000	5,540,708,000	+ 11
1919	1,359,744,000	− 37	3,232,226,000	− 4	3,400,000	4,595,370,000	− 17
1920	1,762,350,000	+ 30	5,152,330,000	+ 59	4,820,000	6,919,500,000	+ 51
Grand total	25,252,900,000	.....	40,022,562,000	.....	82,767,000	65,358,229,000	.....

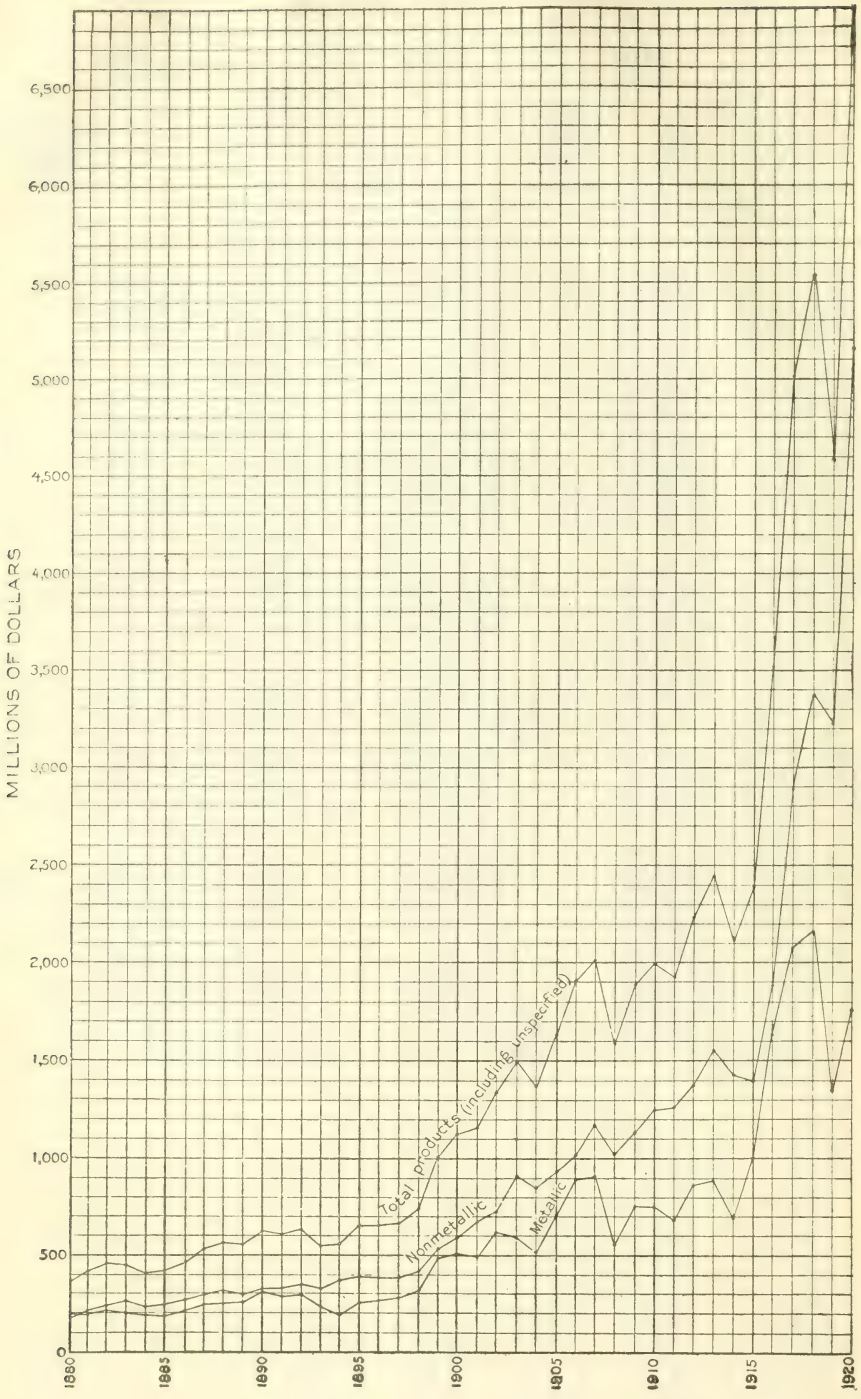

FIGURE 1.—Value of mineral products of the United States, 1880–1920.

Mineral products of the United States and leading producing States, 1920.

Mineral.	Principal producing States in order of value.
Aluminum	New York, North Carolina, Tennessee.
Antimonial lead	Not separable by States.
Arsenious oxide	Not separable by States.
Asbestos	Arizona, Maryland, Georgia, Wyoming.
Asphalt	California, Texas, Oklahoma, Illinois.
Barytes (crude)	Missouri, Georgia, Tennessee, Virginia.
Bauxite	Arkansas, Georgia, Alabama, Tennessee.
Borates	California.
Bromine	Michigan, West Virginia, Ohio.
Cadmium	Not separable by States.
Calcium-magnesium chloride	Michigan, West Virginia, Ohio, California.
Cement	Pennsylvania, Indiana, California, New York.
Chromite	California, Oregon, Wyoming.
Clay:	
Products	Ohio, Pennsylvania, New Jersey, Illinois.
Raw	Pennsylvania, New Jersey, Missouri, Georgia.
Coal:	
Bituminous	Pennsylvania, West Virginia, Illinois, Ohio.
Pennsylvania anthracite	Pennsylvania.
Coke	Pennsylvania, Ohio, Indiana, Alabama.
Copper	Arizona, Montana, Michigan, Utah.
Diatomaceous (infusorial) earth and tripoli	California, Illinois, Missouri, Pennsylvania.
Emery	New York, Virginia.
Feldspar	Maine, Maryland, North Carolina, New York.
Ferroalloys	Pennsylvania, New York, Ohio, Tennessee.
Fluorspar	Illinois, Kentucky, Colorado, New Mexico.
Fuller's earth	Florida, Georgia, Texas, Nevada.
Garnet for abrasive purposes	New York, New Hampshire.
Gems and precious stones	Montana, Nevada, California, Arizona.
Gold	California, Alaska, Colorado, Arizona.
Graphite	Alabama, New York, Rhode Island, Texas.
Grindstones and pulpstones	Ohio, West Virginia, Michigan.
Gypsum	New York, Iowa, Michigan, Ohio.
Iron:	
Ore	Minnesota, Michigan, Alabama, New York.
Pig	Pennsylvania, Ohio, Illinois, New York.
Lead	Missouri, Idaho, Utah, Oklahoma.
Lime	Pennsylvania, Ohio, Missouri, Virginia.
Magnesite (crude)	Washington, California.
Manganese ore	Montana, Arkansas, Virginia, Arizona.
Manganiferous ore	Minnesota, Nevada, Michigan, Colorado.
Mica	North Carolina, New Hampshire, Virginia, Alabama.
Millstones	Virginia, North Carolina, New York, Maryland.
Mineral paints:	
Natural pigments	Canvass discontinued.
Zinc and lead pigments	Pennsylvania, Missouri, Illinois, Wisconsin.
Mineral waters	Wisconsin, New York, California, Maine.
Natural gas	Pennsylvania, West Virginia, Oklahoma, Ohio.
Natural-gas gasoline	Oklahoma, West Virginia, California, Texas.
Nickel	Not separable by States.
Oilstones, etc	Arkansas, Indiana, Ohio, Vermont.
Peat	Illinois, New Jersey, California, North Carolina.
Petroleum	Oklahoma, Texas, California, Kansas.
Phosphate rock	Florida, Tennessee, South Carolina, Idaho.
Platinum and allied metals	Alaska, California, Oregon, Washington.
Potash (K_2O)	Nebraska, California, Utah, Maryland.
Pumice	Kansas, Nebraska, California.
Pyrites	Virginia, California, New York, Colorado.
Quicksilver	California, Texas, Nevada, Oregon.
Salt	Michigan, New York, Kansas, Ohio.
Sand and gravel	Pennsylvania, Ohio, Illinois, New York.
Sand-lime brick	Michigan, Minnesota, Florida, Wisconsin.
Silica (quartz)	Tennessee, Connecticut, Wisconsin, Maryland.
Silver	Utah, Montana, Nevada, Idaho.
Slate	Pennsylvania, Vermont, New York, Maine.
Stone	Pennsylvania, Ohio, Vermont, Indiana.
Sulphur	Louisiana, Texas, Nevada, Wyoming.
Sulphuric acid (smelter)	Ohio, Illinois, Tennessee, Pennsylvania.
Talc and soapstone	New York, Vermont, Virginia, California.
Tin	Alaska, South Dakota.
Titanium ore (rutile)	Virginia.
Tungsten ore	Colorado.
Uranium and vanadium minerals	Colorado, Utah, Arizona, Wyoming.
Zinc	Oklahoma, Montana, New Jersey, Kansas.

Mineral-producing States and their leading mineral products, 1920.

State.	Principal mineral products in order of value.
Alabama	Coal, iron ore, clay products, cement.
Alaska	Copper, gold, silver, coal.
Arizona	Copper, silver, gold, lead.
Arkansas	Coal, bauxite, clay products, natural gas.
California	Petroleum, cement, gold, natural gas.
Colorado	Coal, gold, silver, zinc.
Connecticut	Clay products, stone, lime, sand and gravel.
Delaware	Clay products, stone, sand and gravel.
District of Columbia	Sand and gravel, sand-lime brick, clay products, stone.
Florida	Phosphate rock, fuller's earth, stone, clay products.
Georgia	Clay products, stone, barytes, cement.
Idaho	Lead, silver, zinc, stone.
Illinois	Coal, petroleum, clay products, cement.
Indiana	Coal, cement, clay products, stone.
Iowa	Coal, clay products, cement, gypsum.
Kansas	Petroleum, coal, zinc, cement.
Kentucky	Coal, petroleum, clay products, stone.
Louisiana	Petroleum, sulphur, natural gas, natural-gas gasoline.
Maine	Stone, lime, clay products, feldspar.
Maryland	Coal, clay products, cement, sand and gravel.
Massachusetts	Stone, clay products, lime, sand and gravel.
Michigan	Iron ore, copper, cement, salt.
Minnesota	Iron ore, clay products, stone, cement.
Mississippi	Sand and gravel, clay products, mineral waters, stone.
Missouri	Lead, coal, clay products, cement.
Montana	Copper, zinc, coal, silver.
Nebraska	Potash (K_2O), clay products, cement, sand and gravel.
Nevada	Copper, silver, gold, lead.
New Hampshire	Stone, clay products, sand and gravel, mica.
New Jersey	Clay products, zinc, cement, sand and gravel.
New Mexico	Coal, copper, silver, zinc.
New York	Clay products, cement, stone, salt.
North Carolina	Clay products, stone, mica, sand and gravel.
North Dakota	Coal, clay products, sand and gravel, mineral waters.
Ohio	Coal, clay products, stone, sand and gravel.
Oklahoma	Petroleum, zinc, coal, natural gas.
Oregon	Stone, sand and gravel, gold, cement.
Pennsylvania	Coal, cement, petroleum, natural gas.
Rhode Island	Stone, clay products, lime, graphite.
South Carolina	Clay products, stone, phosphate rock, sand and gravel.
South Dakota	Gold, stone, sand and gravel, gypsum.
Tennessee	Coal, phosphate rock, clay products, zinc.
Texas	Petroleum, sulphur, coal, natural gas.
Utah	Copper, coal, silver, lead.
Vermont	Stone, slate, talc, lime.
Virginia	Coal, clay products, lime, stone.
Washington	Coal, cement, clay products, magnesite.
West Virginia	Coal, petroleum, natural gas, clay products.
Wisconsin	Zinc, iron ore, stone, mineral waters.
Wyoming	Petroleum, coal, natural-gas gasoline, iron ore.

Prices of silver, copper, lead, and zinc, 1911–1920.

Year.	Silver.[a]	Copper.[b]	Lead.[c]	Zinc.[d]	Year.	Silver.[a]	Copper.[b]	Lead.[c]	Zinc.[d]
	Troy oz.	*Pound.*	*Pound.*	*Pound.*		*Troy oz.*	*Pound.*	*Pound.*	*Pound.*
1911	$0.53	$0.125	$0.045	$0.057	1916	$0.658	$0.246	$0.069	$0.134
1912	.615	.165	.045	.069	1917	.824	.273	.086	.102
1913	.604	.155	.044	.056	1918	.98	.247	.071	.091
1914	.553	.133	.039	.051	1919	1.12	.186	.053	.073
1915	.507	.175	.047	.124	1920	1.098	.184	.080	.081

[a] Average price furnished by Bureau of the Mint.

[b] For 1911–1915, U. S. Geological Survey computation for electrolytic copper based on quotations by technical journals. For 1916 and later years, average price, all marketable grades.

[c] For 1911–1915, New York price, U. S. Geological Survey computation from daily market spot quotations. For 1916, from outside spot quotations at New York. For 1917 and later years, average price.

[d] For 1911–1914, St. Louis price, U. S. Geological Survey computation from daily market spot quotations. For 1915 and later years, average price, all grades.

IMPORTS AND EXPORTS.[1]

Value of mineral products imported for consumption in the United States and of mineral products exported from the United States. 1919 and 1920.

Metallic products.

Product.	1919	1920
IMPORTS.		
Aluminum:		
Crude, plates, sheets, leaf, wire, utensils, and manufactures	$4,568,595	$13,077,022
Aluminum salts	21,877	69,896
Antimony (crude and ore)	54,477	70,285
Antimony (metal or regulus)	1,040,789	1,340,278
Antimony (oxide and salts of)	9,501	25,260
Bauxite, crude	36,820	251,284
Bismuth	55,179	161,877
Brass, fit only for remanufacture	2,157,043	5,244,715
Chromic iron ore	1,381,497	1,921,824
Chromium salts	4,271	2,780
Cobalt, and cobalt ore and zaffer	144,282	331,672
Cobalt, oxide of	184,751	399,605
Copper in ore matte, ingots, manufactures	88,859,845	89,086,756
Copper, sulphate of, or blue vitriol	2,825	32,329
Ferroalloys:		
Chrome or chromium , and ferrochrome or ferrochromium	100,404	428,619
Ferrophosphorus	13,388	780
Ferrovanadium	24,923	14,331
Molybdenum and ferromolybdenum	40,759	.....
Titanium and ferrotitanium	3,317	713
Tungsten or wolfram metal and ferrotungsten	287,981	1,180,829
Iron ore	2,385,689	4,963,654
Iron in pigs:		
Ferromanganese	4,283,541	7,775,278
Ferrosilicon	629,362	719,446
Spiegeleisen	1,018	277,900
All other	1,651,185	4,029,210
Lead in ore, base bullion, pigs, sheets, etc	1,760,209	8,163,851
Manganese, oxide, and ore of	11,229,184	12,230,922
Nickel, in ore, matte, sheets, strips, and manufactures	8,424,262	10,857,592
Oxides	324	65
Ores (other steel hardening):		
Molybdenum	77,572	9,707
Titanium	.....	.....
Uranium—radium	.....	1,110
Vanadium	67,846	1,080,935
Zirconium	332	.....
All other	4,227	53,254
Platinum and allied metals:		
Ores of platinum, and unmanufactured	5,229,309	8,474,499
Vases, retorts, all other	17,213	94,408
Iridium, osmium, palladium, rhodium, and ruthenium	1,388,522	1,598,292
Osmiridium	112,403	450,241
Quicksilver	791,226	971,510
Selenium	25,866	.....
Tin, bars, blocks, pigs	50,890,019	73,440,872
Scrap (tin plate)	91,281	84,541
Tungsten-bearing ore	6,261,190	779,593
Type metal	816,642	1,349,495
Uranium salts, and oxide, including some radium salts	12,960	3
Zinc:		
Ore[a]	119,540	198,156
Blocks or pigs	2,284	17
Old worn-out, fit only to be remanufactured	2,216	1,065
Dust	5,753	6,207
Sheets	249	614
All other	1,258	1,746
	195,275,206	251,255,038
Increase	.....	55,979,832
Percentage of increase	.....	29
EXPORTS.		
Aluminum:		
Ingots, metals and alloys	1,495,659	2,244,559
Plates and sheets	249,237	823,058
All other manufactures	2,145,430	2,563,164
Bauxite concentrates	1,372,094	1,843,596
Brass, scrap and old	176,028	254,189

[a] Exclusive of zinc for refining in bonded works for export.

[1] Compiled by Jas. A. Dorsey, of the U. S. Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, of the Department of Commerce.

Value of mineral products imported for consumption in the United States and of mineral products exported from the United States, 1919 and 1920—Continued.

Metallic products—Continued.

Product.	1919	1920
EXPORTS—continued.		
Copper:		
Ore	$95,930	$48,601
Concentrates, matte, and regulus	32,611	30,802
Unrefined, black blister, in pigs, bars, etc	360,089	362,101
Refined copper in ingots, pigs, bars, etc	95,636,546	108,175,745
Composition metal	110,032	117,290
Old and scrap	74,104	99,564
Pipes and tubes	2,206,895	1,757,382
Plates and sheets	4,090,491	6,685,858
Wire, except insulated	14,810,357	10,191,273
All other manufactures	4,557,812	6,040,069
Copper, sulphate of (blue vitriol)	928,291	306,899
Iron:		
Ore	4,308,746	6,198,927
Pig—		
Ferromanganese	445,840	642,570
Ferrosilicon	145,310	41,057
All other	11,722,033	9,390,750
Ferrovanadium	95,560	705,385
Tungsten and ferrotungsten	113,276	5,913
Scrap and old, fit only for remanufacture	717,325	6,411,534
Lead:		
Pigs, bars, etc	1,471,256	462,223
Other manufactures of	2,155,392	3,586,251
Nickel, nickel oxide, and matte	1,697,544	574,845
Manufactures of	2,412,287	1,875,991
Platinum:		
Unmanufactured	75,066	177,115
Manufactured	54,529	111,014
Quicksilver	817,328	129,993
Tin, in pigs, bars	415,921	770,375
Zinc:		
Ore	.....	.....
Dross	739,295	316,637
In pigs, slabs, etc	17,524,153	12,495,144
Rolled in sheets, strips, etc	5,212,002	2,832,993
All other manufactures	538,133	1,057,676
	179,002,602	189,330,533
Increase	.....	10,327,931
Percentage of increase	.....	5.8

Nonmetallic products.

IMPORTS.		
Arsenic, sulphide, etc	$941,181	$1,216,651
Sheep dip Paris green and London purple	12,360	5,427
Asbestos:		
Unmanufactured	7,369,685	9,120,253
Manufactured	187,816	478,915
All other	69,565	139,535
Asphalt	615,499	1,067,616
Barium products:		
Manufactured barytes	.....	3,017
Lithopone	122,708	263,240
Zinc, sulphide of, white	4,413	15,027
Barium carbonate—		
Natural (witherite)	4,739	61,284
Manufactured	2,666	37,462
Barium binoxide	.....	64,447
Barium chloride	19,846	151,778
Blanc-fixe	90	8,485
Barytes, crude	594	146,858
Borax (including crude, refined, and boracic acid)	20,896	12,284
Burrstones and millstones	26,356	20,954
Cement, hydraulic	52,636	1,254,729
Chalk:		
Crude	140,614	267,138
Ground or bolted	6,260	62,561
Precipitated	38,610	10,543
Cubes, blocks, sticks, tailor's, etc	2,995	11,566
Manufactures of (not specially provided for)	325	1,506

Value of mineral products imported for consumption in the United States and of mineral products exported from the United States, 1919 and 1920—Continued.

Nonmetallic products—Continued.

Product.	1919	1920
IMPORTS—continued.		
Clay:		
Kaolin or china clay	$1,965,393	$3,568,677
Other than kaolin	191,945	439,992
Clay products:		
Brick and tile	193,966	414,190
Flattening	2,873	4,908
Pipes, common tobacco pipes, and pipe bowls of clay	15,852	12,091
Pottery, etc.	7,214,209	10,838,681
Coal:		
Anthracite	522,419	257,835
Bituminous	4,950,686	6,733,676
Coke	140,653	403,175
Corundum and emery	595,203	617,187
Cryolite	106,956	193,638
Diatomaceous earth, rotten stone, and tripoli	12,545	16,323
Explosives:		
Fulminates, fulminating powders, etc.:		
Suitable for miners	20	
All other	15,705	479,416
Gunpowder and all other substances (not specially provided for)	6,336,518	5,404
Mining, blasting, or safety fuses of all kinds	1,554	3,771
Percussion caps		50
Bombs, rockets, Roman candles, and fireworks	1,251	4,071
Firecrackers	280,237	740,985
Fertilizers:		
Crude guano, kainite, manure salts, and phosphate	2,447,583	23,423,741
Potassium chloride	1,783,916	12,703,858
Potassium sulphate	188,592	2,343,431
Other potassium salts	280,980	1,289,245
Sodium nitrate	19,558,963	63,121,035
Flint, flints, and flint stones	250,096	338,630
Fluorspar	107,631	265,630
Fuller's earth	189,711	221,893
Gems, and precious stones (including diamond dust and bort)	91,958,830	66,100,742
Granite	27,779	150,355
Graphite	2,978,096	1,711,312
Grindstones, finished and unfinished	50,551	77,046
Gypsum	346,070	587,415
Keenes cement, or other cement of which gypsum is chief value	5,984	5,338
Hones, oilstones, and whetstones	12,199	56,416
Ichthyol	38,975	79,133
Lead paints, litharge, orange mineral, red lead, white lead	8,708	29,237
Lime	128,519	392,137
Lithographic stones, not engraved	216,293	63,733
Magnesia	14,470	84,647
Magnesite	374,032	779,369
Marble and stone (exclusive of granite)	760,190	1,645,220
Mica	1,488,769	3,189,377
Mineral waters	116,948	203,901
Mineral salts, obtained by evaporation from mineral waters	12,339	13,572
Monazite sand and thorium oxide	48,768	141,528
Ocher	219,817	375,672
Peat	16,345	36,201
Petroleum and petroleum products:		
Crude	26,442,881	55,799,254
Benzine, gasoline, and naphtha	1,697,341	4,892,254
Ozokerite (mineral wax)	454,840	499,758
Paraffin oil	60,930	121,049
Paraffin wax	973,521	820,885
All other	3,239,475	5,091,647
Pumice stone	119,781	249,995
Pyrite	2,176,565	1,660,832
Salt	242,704	676,499
Sand	126,586	912,282
Sienna and sienna earths	46,134	145,480
Slate	691	4,512
Strontium salts	3,380	15,479
Sulphur or brimstone	8,633	26,828
Talc	259,004	450,720
Thorium nitrate	5,250	43,221
Umber and umber earths	23,244	85,424
Venetian red	3,509	4,802
Zinc oxide	45,689	293,486
	191,749,151	290,379,567
Increase		98,630,416
Percentage of increase		51

Value of mineral products imported for consumption in the United States and of mineral products exported from the United States, 1919 and 1920—Continued.

Nonmetallic products—Continued.

Product.	1919	1920
EXPORTS.		
Abrasives:		
Wheels, emery and other	$3,032,067	$2,791,128
All other	2,809,231	3,810,171
Asbestos:		
Ore and unmanufactured	157,416	141,071
Manufactured	3,531,978	4,431,132
Asphalt:		
Unmanufactured	1,103,930	1,356,116
Manufactured	606,918	842,074
Cement	7,513,389	10,045,369
Clay:		
Fire	262,501	393,177
All other	249,571	775,222
Coal:		
Anthracite	36,668,131	45,538,100
Bituminous	[a] 83,708,842	[a] 304,273,241
Coke	5,128,119	9,993,665
Earthen, stone, and china ware:		
Building brick	248,690	382,814
Fire brick	2,747,512	4,200,266
Chinaware	523,861	816,817
Earthenware and stoneware	1,148,051	1,241,938
Sanitary earthenware	563,734	778,714
Tiles, except drain	628,836	1,025,083
All other	721,600	951,991
Fertilizers (phosphate rock, ground or unground):		
High-grade hard rock	2,261,852	4,496,457
Land pebble	904,308	5,593,814
All other	401,822	479,904
Graphite:		
Unmanufactured	90,185	112,771
Manufactures	788,755	610,261
Lime	108,370	128,296
Mica, and manufactures	109,348	316,169
Paints:		
Red lead	735,177	365,575
White lead	3,037,292	3,195,101
Zinc oxide	3,059,276	2,151,544
Petroleum and petroleum products:		
Crude	14,805,546	28,990,444
Gasoline	61,756,864	104,992,832
Naphtha	30,290,030	70,547,541
Illuminating	119,024,479	133,290,080
Fuel oil and gas oil	[b] 30,818,877	[b] 54,888,724
Lubricating:		
Paraffin	1,795,612	847,695
All other	83,347,739	154,758,909
Jelly, etc	2,594,338	3,520,093
Paraffin and paraffin wax	24,816,800	32,619,318
Residuum	1,834,285	1,040,987
Plaster, builders' and common	164,324	436,132
Wall board (substitute for plaster)	1,141,815	1,565,920
Potash:		
Chlorate	524,193	445,243
All other	2,231,351	3,116,772
Salt	1,396,625	1,901,593
Sand and gravel	382,070	669,945
Soda:		
Bicarbonate	[c]	616,261
Borax	[c]	1,206,936
Caustic	6,748,762	10,944,017
Sal soda	178,285	220,487
Silicate	338,818	450,770
Soda ash	2,656,608	4,689,591
Other salts of soda	7,226,322	7,161,784
Stone, including marble:		
Unmanufactured	770,392	774,442
Grindstones	297,068	424,322
Roofing slate	55,164	122,105
All other	1,508,997	2,158,764
Sulphur or brimstone	6,325,552	8,994,350
	565,881,678	1,042,634,038
Increase		476,752,360
Percentage of increase		84

[a] Does not include fuel or bunker coal laden on vessels engaged in the foreign trade, which aggregated in value $48,205,675 in 1919 and $82,461,518 in 1920.

[b] Does not include fuel or bunker oil laden on vessels engaged in the foreign trade, which aggregated in value $29,383,438 in 1919 and $66,679,056 in 1920.

[c] Not separately stated prior to Jan. 1, 1920.

DETAILED TABLES.

ABRASIVE MATERIALS.

PRODUCTION.

Natural abrasives marketed by producers in the United States, 1915–1920.

Abrasive.	1915		1916		1917	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Millstones	(a)	$53,480	(a)	$44,559	(a)	$43,489
Grindstones and pulpstones	b 42,623	648,479	b 50,839	766,140	b 54,432	1,147,784
Oilstones and scythestones	(a)	115,175	(a)	154,573	1,816	168,704
Emery and corundum	c 3,063	c 31,131	c 15,282	c 123,901	17,135	241,050
Garnet	4,301	139,584	6,171	208,850	4,995	198,327
Abrasive quartz and feldspar	(d)	(d)	(d)	(d)	(d)	(d)
Diatomaceous (infusorial) earth and tripoli e	35,304	167,474	45,978	241,553	29,102	369,556
Pumice	27,708	63,185	33,320	82,263	35,293	84,814
Grinding pebbles	.....	.....	(a)	42,500	12,000	72,191
Tube-mill lining	.....	.....	.....	.....	3,050	59,250
	.....	1,218,508	.....	1,664,339	.....	2,385,165

Abrasive.	1918		1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Millstones	(a)	$92,514	(a)	$66,972	(a)	$63,325
Grindstones and pulpstones	65,339	1,776,282	46,865	1,336,015	53,484	1,707,004
Oilstones and scythestones	1,010	189,033	1,463	235,943	1,144	231,747
Emery and corundum	10,422	112,878	c 2,601	c 23,203	c 2,327	c 21,685
Garnet	4,696	248,161	4,944	310,131	5,476	434,425
Abrasive quartz and feldspar	(d)	(d)	(d)	(d)	(d)	(d)
Diatomaceous (infusorial) earth and tripoli e	22,947	224,801	66,934	713,501	102,155	1,649,370
Pumice	30,637	91,178	36,051	116,835	41,838	114,433
Grinding pebbles	9,934	82,851	9,448	85,302	10,924	77,823
Tube-mill lining	2,535	46,634				
	.....	2,864,332	.....	2,887,902	.....	4,299,812

a Figures not available, as product was not reported by weight.
b Quantity represents grindstones only, as pulpstones were not reported by weight.
c Emery only. No corundum produced.
d See sections on feldspar and silica (quartz).
e Includes rottenstone, but excludes from 1915 to 1918, inclusive, considerable production of diatomaceous earth for special uses upon which the Survey is not at liberty to report.

IMPORTS.

Value of abrasive materials imported for consumption in the United States, 1915–1920.

Material.	1915	1916	1917	1918	1919	1920
Millstones and burrstones	$17,027	$19,816	$18,227	$20,017	$26,356	$20,954
Grindstones and pulpstones	68,892	63,277	57,950	27,361	50,551	77,046
Hones, oilstones, and whetstones	14,247	10,614	10,636	6,075	12,199	56,416
Emery and corundum	271,649	240,737	210,602	614,167	595,203	617,187
Diatomaceous earth, tripoli, and rottenstone	27,333	37,573	17,864	11,128	12,545	16,323
Pumice	65,691	116,543	147,278	33,014	119,781	249,995
Diamond dust and bort	75,944	67,290	349,746	475,870	1,420,442	3,387,488
	540,783	555,850	812,303	1,187,632	2,237,077	4,425,409

EXPORTS.

Value of domestic abrasive materials exported from the United States, 1915–1920.

Material.	1915	1916	1917	1918	1919	1920
Grindstones	$128,879	$176,563	$198,772	$210,889	$297,068	$424,322
Abrasive wheels, emery, and other	1,200,421	2,240,227	4,481,600	3,862,531	3,032,067	2,791,128
All other	1,403,796	2,035,951	1,941,512	1,982,822	2,809,231	3,810,171

ALUMINUM.

[See under Bauxite and aluminum.]

ANTIMONY AND ANTIMONIAL LEAD.

PRODUCTION.

Mine production of antimony ores in the United States, 1915–1920.[a]

Year.	Quantity (short tons).	Antimony content (short tons).
1915	5,000	2,100
1916	4,500	1,770
1917	1,060	390
1918	190	50
1919	0	0
1920	0	0

[a] Mine production negligible prior to 1915.

Smelter production of metallic antimony in the United States, 1917–1920.[a]

Year.	From domestic ores.		From foreign ores.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1917	258	$106,812	2,182	$903,348	2,440	$1,010,160
1918	127	32,004	2,490	627,480	2,617	659,484
1919	0	0	(b)	(b)	(b)	(b)
1920	0	0	(b)	(b)	(b)	(b)

[a] Not recorded prior to 1917.
[b] Only two smelters reporting production in 1919 and one in 1920 and Survey not at liberty to publish figures.

Secondary antimony and antimony content of secondary alloys recovered from old alloys, scrap, and dross in the United States, 1913–1920.

Year.	Quantity (short tons).	Value.[a]	Year.	Quantity (short tons).	Value.[a]
1913	2,705	$401,963	1917	4,961	$2,061,700
1914	2,646	444,844	1918	5,226	1,317,000
1915	3,102	1,811,568	1919	4,399	717,900
1916	4,480	2,270,016	1920	5,600	938,560

[a] Values calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1913–1920.

Year.	Quantity (short tons).	Value.	Antimony content (short tons).	Year.	Quantity (short tons).	Value.	Antimony content (short tons).
1913	16,665	$1,591,854	2,508	1917	18,646	$3,781,560	2,759
1914	16,667	1,572,167	2,693	1918	18,570	2,826,350	2,566
1915	23,224	3,665,736	3,425	1919	13,874	1,513,968	1,943
1916	24,038	4,483,582	3,496	1920	12,535	1,963,255	2,033

IMPORTS.

Antimony imported and entered for consumption in the United States, 1913 and 1915–1920.

Year.	Antimony ore.[a]			Liquated antimony sulphide.[b]		Metallic antimony.[c]		Antimony oxide and other compounds.[d]	
	Quantity (short tons).	Antimony content (short tons).	Value of antimony content.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	2,860	2,007	$137,361	3	$419	6,240	$798,581	984	$117,169
1915	2,494	1,544	332,125	.....	.....	7,354	2,660,830	423	132,193
1916	7,840	4,622	1,072,340	.....	.....	7,064	3,548,507	243	109,832
1917	10,083	5,832	1,006,884	796	128,660	11,286	2,829,159	10	5,368
1918	3,363	1,425	177,731	833	113,258	14,011	3,065,619	18	11,904
1919	993	409	54,477	278	19,202	7,159	1,021,587	126	9,501
1920	1,709	682	70,285	1,375	123,902	9,817	1,216,376	298	25,260

[a] Classified in tariff classification as "Antimony ore and stibnite containing antimony."
[b] Classified in tariff classification as "Antimony matte, containing not more than 10 per cent of lead."
[c] Classified in tariff classification as "Antimony regulus or metal."
[d] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."

EXPORTS.

Foreign antimony exported from the United States, 1915–1920.[a]

Year.	Ore.			Matte, regulus, or metal.	
	Quantity (short tons).	Antimony content (pounds).	Value.	Quantity (pounds).	Value.
1915	.....	195	$8	3,146,135	$786,766
1916	231	255,695	9,874	3,018,251	761,045
1917	.....	.....	.....	989,477	169,260
1918	.....	.....	.....	1,410,970	164,666
1919	3	5,380	1,665	429,059	33,913
1920	.....	.....	.....	896,034	51,607

[a] There are no domestic exports.

PRICES.

The average New York prices for the ordinary grades of metallic antimony for the last 10 years, in cents per pound, are given by the Engineering and Mining Journal as follows:

Average price (cents per pound) of metallic antimony at New York, 1911–1920, by years.

1911	7.54	1916	25.37
1912	7.76	1917	20.69
1913	7.52	1918	12.58
1914	8.76	1919	8.19
1915	30.28	1920	8.49

ARSENIC.

PRODUCTION.

White arsenic (As_2O_3) produced in the United States, 1911–1920.

Year.	Quantity (short) tons).	Value.	Year.	Quantity (short tons).	Value.
1911	3,132	$73,408	1916	5,986	$555,187
1912	3,141	190,757	1917	6,151	1,118,313
1913	2,513	159,236	1918	[a] 6,323	1,213,000
1914	4,670	313,147	1919	[a] 6,029	[b] 1,181,684
1915	5,498	302,116	1920	11,502	2,021,356

[a] Includes metallic arsenic produced from ore.
[b] Only two companies reported production of white arsenic in 1919 and both have given permission to show quantity but not value. This value has been estimated at 9.8 cents a pound.

IMPORTS.

Arsenic compounds imported and entered for consumption in the United States, 1913 and 1915–1920.

Year.	Arsenic or arsenious acid (white arsenic, As_2O_3).		Arsenic and sulphide of, or orpiment.		Sheep dip.		Paris green and London purple.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
1913	1,519	$133,597	3,182	$276,849	[a]	$40,036	99,692	$4,431
1915	1,400	113,677	1,783	154,099	[a]	19,916	21,056	4,069
1916	1,071	107,876	1,092	124,818	[a]	20,134	23,461	5,028
1917	1,178	264,534	2,777	410,341	[a]	15,848	48	189
1918	1,847	441,212	4,842	840,600	[a]	23,538	.....	.....
1919	4,389	624,494	2,151	316,687	146,803	12,346	18	14
1920	3,740	532,635	4,080	684,016	70,168	5,150	772	277

[a] Figures not available.

EXPORTS.

Foreign arsenic and sulphide of, or orpiment, exported from the United States, 1913–1920.[a]

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1913	60,000	$3,135	1917	113,600	$15,840
1914	700	79	1918	80,050	12,017
1915	9,776	526	1919	.....	.....
1916	1,761	1,256	1920	13,799	1,827

[a] There are no domestic exports.

ASBESTOS.

SUPPLY.

Supplies of asbestos in the United States, 1913 and 1915–1920.

Year.	Domestic shipments.		Imports (unmanufactured).[a]		Exports (unmanufactured).		Apparent consumption.[b]	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	1,100	$11,000	97,069	$1,928,705	(c)	(c)	(c)	(c)
1915	1,731	76,952	93,567	1,981,483	(c)	(c)	(c)	(c)
1916	1,479	448,214	116,162	3,303,470	d 312	d $6,133	(c)	(c)
1917	1,683	506,056	134,088	4,521,172	708	116,580	135,063	$4,910,648
1918	1,002	124,687	137,700	6,337,608	697	51,053	138,005	6,411,242
1919	1,161	248,265	135,270	7,369,685	1,119	157,416	135,312	7,460,534
1920	1,648	650,311	167,558	9,120,253	615	141,071	168,591	9,629,493

[a] Imports for consumption and mainly from Canada.
[b] Production plus imports minus exports.
[c] Exports not separately recorded prior to July, 1916.
[d] Figures cover period July to December, 1916.

WORLD'S PRODUCTION.

World's production of asbestos, 1913 and 1915–1920, by countries, in metric tons.

Country.	1913	1915	1916	1917	1918	1919	1920
Australia[a]	.....	.....	37	280	2,900	251	164
British South Africa:							
Rhodesia[b]	263	1,823	5,586	8,675	7,778	8,889	17,076
Union[c]	873	1,940	4,224	5,642	3,333	3,567	6,452
Canada[d]	124,239	100,826	121,053	122,925	128,334	124,070	162,037
China[e]	.....	.....	.....	378	243	69	(f)
Chosen[g]	.....	.....	.....	.....	.....	118	(f)
Cyprus[h]	1,187	1,117	1,312	1,086	232	1,352	910
India[i]	.....	.....	.....	150	363	394	(f)
Italy[j]	175	163	82	85	60	98	(f)
Philippine Islands[k]	.....	.....	.....	.....	70	375	(f)
Russia[l]	17,494	9,779	8,192	(f)	.....	.....	.....
United States	998	1,570	1,342	1,527	909	1,053	1,495
	145,229	117,218	141,828	140,748	144,222	140,236	[m] 189,000

[a] Western Australia, Repts. Secretary Mines. Southern Australia Dept. Mines, Review of mining operations. Tasmania, Repts. Secretary Mines. New South Wales Repts. Dept. Mines.
[b] Southern Rhodesia Secretary Mines, Ann. Repts.
[c] Union of South Africa Secretary Mines, etc., Ann. Repts.
[d] Canada Dept. Mines, Mines Branch, Ann. Repts. of mineral production.
[e] U. S. Dept. Commerce, Commerce Rept. 77, Apr. 1, 1920. Figures in table above in part estimated from values.
[f] Figures not yet available.
[g] American consul, Tokyo. Data from Japan Dept. Agr. and Commerce, Mining Bur.
[h] Imperial Mineral Resources Bur., The mineral industry of the British Empire and foreign countries—Asbestos, war period (1913–1919), p. 28, 1921. 1919–1920: Official figures furnished to the American diplomatic agency, Cairo, Egypt.
[i] India Geol. Survey Records.
[j] 1913–1918, Rivista del servizio minerario. 1919, Revista minera, metalúrgica y de ingeniería, Jan. 24, 1921.
[k] Philippine Bur. Sci., Div. Mines, Mineral Resources.
[l] Mining Jour., London, Feb. 9, 1918. Figures for 1915 and 1916 are estimated.
[m] Total includes estimates for figures not yet available.

ASPHALT AND RELATED BITUMENS.

PRODUCTION.

Asphalt produced in the United States from domestic petroleum, 1911–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	277,192	$3,173,859	1916	688,334	$6,178,851
1912	354,344	3,755,506	1917	701,809	7,734,691
1913	436,586	4,531,657	1918	604,723	8,796,541
1914	360,683	3,016,969	1919	614,692	8,727,372
1915	664,503	4,715,583	1920	700,496	11,985,457

Asphalt produced in the United States from Mexican petroleum, 1913–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1913	114,437	$1,743,749	1917	645,613	$7,441,813
1914	313,787	4,131,153	1918	597,697	9,417,818
1915	388,318	3,730,436	1919	674,876	7,711,510
1916	572,387	6,018,851	1920	1,045,779	14,272,862

Native asphalt and related bitumens produced in the United States, 1911–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	87,074	$817,250	1916	98,477	$923,281
1912	95,166	865,225	1917	81,604	773,424
1913	92,604	750,713	1918	60,034	780,808
1914	79,888	642,123	1919	88,281	682,989
1915	75,751	526,490	1920	198,497	1,213,908

IMPORTS.

Asphalt and related bitumens imported for consumption in the United States, 1913 and 1915–1920.

Year.	Crude asphalt.		Dried or advanced asphalt.		Ozokerite.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	[a] 207,033	$738,452	[a] 14,750	$133,336	3,571	$549,992
1915	135,276	661,356	.....	.....	1,398	210,019
1916	147,383	732,917	.....	.....	1,504	196,185
1917	187,473	978,087	.....	.....	450	90,510
1918	114,686	624,967	.....	.....	905	147,805
1919	104,913	609,923	.....	.....	1,874	454,840
1920	127,027	1,055,951	.....	.....	2,136	499,758

Year.	Ichthyol.		Bituminous limestone.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	29	$83,034	6,395	$38,823	231,778	$1,543,637
1915	12	28,560	2,976	19,001	139,662	918,936
1916	58	93,762	330	1,795	149,275	1,024,659
1917	29	36,232	413	15,028	188,365	1,119,857
1918	33	39,452	39	2,528	115,663	814,752
1919	15	38,975	735	5,576	107,537	1,109,314
1920	49	79,133	1,387	11,665	130,599	1,646,507

[a] Last three months of 1913, dried or advanced asphalt included in figures for crude asphalt.

EXPORTS.

Asphalt exported from the United States, 1913 and 1915–1920.

Year.	Unmanufactured.		Manufactures of (value).	Total value.
	Quantity (short tons).	Value.		
1913	65,576	$1,267,625	$411,786	$1,679,411
1915	42,787	735,952	438,685	1,174,637
1916	40,816	759,769	494,895	1,254,664
1917	30,107	587,256	585,472	1,172,728
1918	22,108	577,654	577,936	1,155,590
1919	40,208	1,103,930	606,918	1,710,848
1920	51,706	1,356,116	842,074	2,198,190

BARYTES AND BARIUM PRODUCTS.

BARYTES.

SUPPLY.

Supplies of crude barytes in the United States, 1913 and 1915–1920.

Year.	Domestic barytes marketed.		Imports for consumption.		Apparent consumption.[a]	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	45,298	$156,275	35,840	$61,409	81,138	$217,684
1915	108,547	381,032	2,504	4,877	111,051	385,909
1916	221,952	1,011,232	17	245	221,969	1,011,477
1917	206,888	1,171,184	6	63	206,894	1,171,247
1918	155,368	1,044,905	.....	.....	155,368	1,044,905
1919	209,330	1,727,822	118	594	209,448	1,728,416
1920	228,113	2,142,464	24,874	146,858	252,987	2,289,322

[a] No exports reported. Stocks at plants included, but those at mines excluded.

PRODUCTION.

Crude domestic barytes marketed in the United States, 1919 and 1920, by States.

State.	1919			1920		
	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.
California	(a)	(a)	(a)	2,250	$20,850	$9.27
Georgia	85,303	$667,521	$7.83	84,644	790,362	9.34
Kentucky	5,435	36,408	6.70	(a)	(a)	(a)
Missouri	73,247	640,398	8.74	99,654	1,013,570	10.17
Tennessee	34,700	288,622	8.32	29,319	213,657	7.29
Other States [b]	10,645	94,873	8.91	12,246	104,025	8.49
	209,330	1,727,822	8.25	228,113	2,142,464	9.39

[a] Included under "Other States."
[b] 1919: Alabama, California, Illinois, Nevada, North Carolina, South Carolina, Virginia, and Wisconsin; 1920: Same States as in 1919, with California excluded and Kentucky in addition.

CONSUMPTION.

Crude domestic and imported barytes used in the manufacture of barium products in the United States, 1916–1920, in short tons.

Year.	In manufacture of—		
	Ground barytes.	Lithopone.	Barium chemicals.
1916	75,507	71,898	38,283
1917	60,132	86,065	49,842
1918	62,440	85,282	38,041
1919	64,922	103,688	32,976
1920	79,052	113,181	37,210

BARIUM PRODUCTS.

PRODUCTION.

Barium products of domestic manufacture (from either domestic or imported crude ore) marketed[a] in the United States, 1915–1920, in short tons.

Product.	1915	1916	1917	1918	1919[a]	1920
Ground barytes	51,557	65,440	52,694	55,086	57,985	65,748
Lithopone	46,494	51,291	63,713	62,403	79,643	89,373
Barium chemicals	8,823	16,792	22,503	23,186	20,013	20,760
	106,874	133,523	138,910	140,675	157,641	175,881

[a] Figures for 1919 represent production.
[b] In order to avoid duplication of figures, barium chemicals manufactured from secondary products bought in open market are not included in table.

Barium chemicals of domestic manufacture marketed in the United States, 1915–1920, in short tons.[a]

Chemical.	1915	1916	1917	1918	1919	1920
Barium binoxide	(b)	1,980	(b)	(b)	(b)	(b)
Barium carbonate	2,746	6,844	8,238	7,661	7,135	7,484
Barium chloride	2,106	3,643	4,870	4,530	4,509	3,084
Barium nitrate	971	446	165	(b)	(b)	(b)
Barium sulphate (blanc fixe)	(b)	3,337	6,314	9,522	5,227	8,046
Other barium chemicals[c]	3,000	542	2,916	1,473	3,142	2,146
	8,823	16,792	22,503	23,186	20,013	20,760

[a] In order to avoid duplication of figures, barium chemicals manufactured from secondary products bought in open market are not included in table.
[b] Included under "Other barium chemicals."
[c] 1920: Barium binoxide, barium hydroxide, barium nitrate, and barium sulphide.

IMPORTS.

Value of barium compounds imported and entered for consumption in the United States, 1913 and 1915–1920.

Product.	1913	1915	1916	1917	1918	1919	1920
Manufactured barytes[a]	$38,155	$10,736	$2,072	$1,743	.....	.....	$3,017
Lithopone	146,474	137,816	405,730	29,199	.....	$122,708	263,240
Barium carbonate:							
Natural (ground witherite)	13,116	12,165	18,169	17,321	$14,134	4,739	61,284
Manufactured (chemically precipitated)	38,949	2,786	.....	1,554	.....	2,666	37,462
Barium binoxide	239,000	218,776	6,590	.....	.....	.....	64,447
Barium chloride	37,620	31,295	608	.....	.....	19,846	151,778
Blanc fixe, or barium sulphate (chemically precipitated)	62,785	18,501	17,810	3,333	.....	90	8,485
	576,099	432,075	450,979	53,150	14,134	150,049	589,713

[a] "Manufactured barytes," as given by the Bureau of Foreign and Domestic Commerce, is believed to be the equivalent of "ground barytes" as used by the Geological Survey.

BAUXITE AND ALUMINUM.

BAUXITE.

SUPPLY.

Bauxite supplies in the United States, 1913 and 1915–1920.

Year.	Domestic production.					
	Georgia, Alabama, and Tennessee.		Arkansas.		Total.	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1913	40,370	$150,710	169,871	$846,988	210,241	$997,698
1915	28,245	144,345	268,796	1,370,489	297,041	1,514,834
1916	49,190	284,810	375,910	2,011,590	425,100	2,296,400
1917	62,134	395,051	506,556	2,724,007	568,690	3,119,058
1918	42,829	314,112	562,892	3,133,880	605,721	3,447,992
1919	43,076	346,588	333,490	1,855,159	376,566	2,201,747
1920	40,029	349,453	481,279	2,897,892	521,308	3,247,345

Year.	Imports.		Exports.[a]		Apparent domestic consumption.	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1913	21,456	$85,746	(b)	(b)	231,697	$1,083,444
1915	3,420	17,107	16,082	$717,186	284,379	814,755
1916	30	87	17,939	987,454	407,191	1,309,033
1917	7,691	28,989	21,791	1,323,926	554,590	1,824,121
1918	3,653	14,791	19,711	1,523,688	589,663	1,939,095
1919	6,082	36,820	17,701	1,372,094	364,947	866,473
1920	42,895	251,284	22,257	1,843,596	541,946	1,655,033

[a] Includes bauxite concentrates.
[b] Not separately classified by Bureau of Foreign and Domestic Commerce prior to July, 1914.

WORLD'S PRODUCTION.

World's production of bauxite, 1913 and 1916–1920, by countries, in metric tons.

Country.	1913	1916	1917	1918	1919	1920
Austria (Dalmatia and Istria)	(a)	b142,326	b163,122	b155,000	(a)	(c)
British Guiana			2,070	4,266	2,008	b27,872
British India	1,203	762	1,385	1,211	1,709	(a)
France	309,294	b106,170	b120,883	(a)	159,103	b186,693
Hungary	(a)	(a)	16,213	(a)	(a)	(a)
Italy	6,952	8,887	7,789	7,800	2,972	b c 37,960
Spain				460	1,780	(a)
United Kingdom	6,152	10,495	14,960	9,743	9,369	11,197
United States	213,615	431,923	577,817	615,443	382,610	529,675

[a] Figures not yet available.
[b] Unofficial.
[c] Production of Dalmatia and Istria (33,860 tons) included under Italy.

ALUMINUM.

PRODUCTION.

Value of aluminum produced in the United States, 1913–1920.

Year.	Primary metal.	Secondary metal.[a]	Year.	Primary metal.	Secondary metal.[a]
1913	$9,450,000	$2,199,480	1917	$45,882,000	$16,711,800
1914	10,080,000	1,673,140	1918	41,159,600	10,113,600
1915	16,280,000	5,802,100	1919	38,558,000	12,014,600
1916	33,900,000	23,430,200	1920	41,375,000	9,489,100

[a] Value based on average price, as given by the American Metal Market.

IMPORTS.

Aluminum imported for consumption in the United States, 1913 and 1915–1920.

Year.	Crude and semicrude.[a]		Manufactures of.[b]	Total value.
	Quantity (pounds).	Value.		
1913	25,095,441	$4,388,283	$396,019	$4,784,302
1915	9,293,574	1,765,967	75,812	1,841,779
1916	6,698,615	1,752,918	32,952	1,785,870
1917	89,291	35,386	21,504	56,890
1918	1,690,683	533,704	20,882	554,586
1919	13,852,065	4,530,579	38,016	4,568,595
1920	39,298,649	12,183,891	893,131	13,077,022

[a] Includes crude aluminum, plates, sheets, and wire.
[b] Includes aluminum leaf, kitchen utensils, and all other manufactures of aluminum.

EXPORTS.

Aluminum and manufactures of aluminum exported from the United States, 1913–1920.

Year.		Crude and semicrude.[a]		Manufactures of.	Total value.
		Quantity (pounds).	Value.		
1913				$966,094	$21,611,855
1914				1,546,510	
1915				3,682,117	
1916				15,417,134	
1917	Jan.–June			9,029,458	14,586,467
	July–Dec.	10,020,404	$4,571,193	985,816	
1918		24,135,234	8,979,315	1,890,073	10,869,388
1919		5,020,352	1,744,896	2,145,430	3,890,326
1920		9,407,631	3,067,617	2,563,164	5,630,781

[a] Includes ingots, metal and alloys, plates and sheets.

PRICES.

Prices of aluminum in the United States, 1913–1920, in cents per pound.[a]

Year.	Average open market price, small lots.	Year.	Average open market price, small lots.
1913	23.64	1917	51.59
1914	18.63	1918	33.42
1915	33.98	1919	32.38
1916	60.71	1920	33.07

[a] Engineering and Mining Journal quotations.

BISMUTH.

PRODUCTION.

The output of domestic bismuth in 1920 is known to have been much smaller than in 1919, but no figures may be given as the producers object to having their output shown. The bismuth produced in this country is almost entirely a by-product obtained in the refining of lead bullion.

IMPORTS.

Bismuth imported for consumption in the United States, 1913–1920.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1913	117,747	$213,257	1917	69,250	$142,300
1914	90,505	165,208	1918	135,700	277,273
1915	44,362	108,288	1919	57,607	55,179
1916	76,723	195,975	1920	72,771	161,877

EXPORTS.

No exports of bismuth are recorded.

BORAX.

[See under Sodium compounds.]

BRIQUETS (FUEL).

PRODUCTION.

Fuel briquets produced in the United States, 1911–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	218,443	$808,721	1916	295,155	$1,445,662
1912	220,064	952,261	1917	406,856	2,233,888
1913	181,859	1,007,327	1918	477,235	3,212,793
1914	250,635	1,154,678	1919	295,734	2,301,054
1915	221,537	1,035,716	1920	567,192	4,623,831

Raw fuels used in making briquets in the United States, 1918–1920, in short tons.

Fuel.	1918	1919	1920	Fuel.	1918	1919	1920
Anthracite culm and fine sizes	209,690	104,027	330,136	Lignite and subbituminous coal	76,602	80,383	89,656
Semianthracite				Oil-gas residue			
Semibituminous	180,714	111,955	152,247				
Bituminous slack					467,006	296,365	572,039

IMPORTS.

Composition used for fuel in which coal or coal dust is the component material of chief value, whether in briquets or other form, imported for consumption in the United States, 1913–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1913		$2,455	1918	(a)	a $280
1914		209		b 432	b 2,797
1915		46	1919	136	1,050
1916		75	1920	112	9
1917					

a Figures cover 6 months, January to June. Quantity not shown prior to July.
b Figures cover 6 months, July to December.

BROMINE.

PRODUCTION.

Bromine marketed in the United States, 1913–1920.

Year.	Quantity (pounds).	Value.	Average price per pound.	Year.	Quantity (pounds).	Value.	Average price per pound.
1913	572,400	$115,436	$0.20	1917	895,499	$492,703	$0.55
1914	576,991	203,094	.35	1918	1,727,156	970,099	.56
1915	855,857	856,307	1.00	1919	1,854,971	1,234,969	.67
1916	728,520	951,932	1.31	1920	1,160,584	745,381	.64

IMPORTS.

No imports of bromine are recorded for 1920.

EXPORTS

Exports are not specifically shown.

CADMIUM.

PRODUCTION.

Metallic cadmium and cadmium sulphide produced in the United States, 1913 and 1915–1920.

Year.	Metallic cadmium.			Cadmium sulphide.		
	Quantity (pounds).	Value.	Average price per pound.	Quantity (pounds).	Value.	Average price per pound.
1913	54,198	$41,838	$0.77	17,302	$12,136	$0.70
1915	91,415	108,443	1.19	10,624	12,057	1.13
1916	135,212	210,931	1.56	22,176	27,942	1.26
1917	207,408	305,097	1.47	50,169	70,939	1.41
1918	127,164	188,203	1.48	51,702	70,315	1.36
1919	99,939	121,926	1.22	31,197	37,436	1.20
1920	129,283	151,261	1.17	32,133	37,274	1.16

IMPORTS.

Cadmium imported and entered for consumption in the United States, 1911–1920.[a]

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1911	5,367	$3,870	1914	441	$368
1912	5,250	3,764	1915	269	284
1913	1,656	1,232			

a No cadmium was imported from 1916 to 1920.

EXPORTS.

Statistics of the exports of cadmium are not separately kept by the Bureau of Foreign and Domestic Commerce, Department of Commerce, and hence are not regularly available, but it is known that domestic cadmium was largely exported during the World War. Special canvasses show that about 40,000 pounds of cadmium were exported in 1918, of which the larger part went to France.

CALCIUM CHLORIDE.

PRODUCTION.

Calcium-magnesium chloride marketed in the United States, 1913–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.	Year.	Quantity (short tons).	Value.	Average price per ton.
1913	19,611	$130,030	$6.63	1917	30,503	$451,480	$14.80
1914	19,403	121,766	6.28	1918	26,624	503,452	18.91
1915	20,535	130,830	6.37	1919	26,123	321,596	12.31
1916	27,709	224,997	8.12	1920	27,849	539,471	19.37

IMPORTS AND EXPORTS.

Imports and exports of calcium chloride are not specifically shown.

CARBON BLACK.

PRODUCTION.

Carbon black produced from natural gas in the United States in 1919 and 1920.

Year.	Number of plants.	Carbon black produced.			Gas used.	
		Quantity (pounds).	Value.	Average price per pound (cents).	Quantity (M. cu. ft.).	Average yield of carbon black per thousand cubic feet (pounds).
1919	36	52,056,941	$3,816,040	7.3	49,896,235	1.04
1920	35	51,321,892	4,032,286	7.9	40,598,978	1.26

CEMENT.

SUPPLY.

Supplies of Portland cement in the United States, 1913 and 1915–1920.

Year.	Domestic shipments.		Imports.		Exports.		Apparent consumption.[a]	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.	Quantity (barrels).	Value.	Quantity (barrels).	Value.
1913	88,689,377	$89,106,975	85,470	$139,416	2,964,358	$4,270,666	85,810,489	$84,975,725
1915	86,891,681	74,756,674	42,218	57,174	2,565,031	3,361,451	84,368,868	71,452,397
1916	94,552,296	104,258,216	1,836	4,942	2,563,976	3,828,231	91,990,156	100,434,927
1917	90,703,474	122,775,088	2,323	6,076	2,586,215	5,328,536	88,119,582	117,452,628
1918	70,915,508	113,316,275	305	1,200	2,252,446	5,912,166	68,663,367	107,405,309
1919	85,612,899	146,734,844	8,931	52,636	2,463,573	7,513,389	83,158,257	139,274,091
1920	96,311,719	194,439,025	524,604	1,254,729	2,985,807	10,045,369	93,850,516	185,648,385

[a] Domestic shipments plus imports minus exports.

PRODUCTION.

Principal hydraulic cements produced in the United States, 1913 and 1915–1920.

Year.	Natural cement.		Portland cement.	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.
1913	744,658	$345,889	92,097,131	$92,557,617
1915	750,863	358,627	85,914,907	73,886,820
1916	[a] 842,137	[a] 430,874	91,521,198	100,947,881
1917	[a] 639,456	[a] 435,370	92,814,202	125,670,430
1918	[a] 432,966	[a] 401,341	71,081,663	113,730,661
1919	[a] 528,589	[a] 583,554	80,777,935	138,130,269
1920	[a] 767,481	[a] 1,150,890	100,023,245	202,046,955

Year	Puzzolan cement.		Total.	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.
1913	107,313	$97,663	92,949,102	$93,001,169
1915	42,678	39,801	86,708,448	74,285,248
1916	(a)	(a)	92,363,335	101,378,755
1917	(a)	(a)	93,453,658	126,105,800
1918	(a)	(a)	71,514,629	114,132,002
1919	(a)	(a)	81,306,524	138,713,823
1920	(a)	(a)	100,790,726	203,197,845

[a] Figures for puzzolan included with natural cement.

Portland cement produced, shipped, and in stock in the United States, 1919 and 1920, by States.

State.	Production.					Shipments.							Stock (barrels).	
	Active plants.		Quantity (barrels).		Per cent-age of in-crease.	1919		1920		Per-centage of change in quan-tity.	Average factory price per barrel.		1919	1920
	1919	1920	1919	1920		Quantity (barrels).	Value.	Quantity (barrels).	Value.		1919	1920		
California	8	9	4,642,679	7,098,084	53	4,743,336	$8,860,196	7,064,010	$15,449,645	+49	$1.87	$2.19	430,003	463,930
Illinois	4	4	4,206,918	5,538,558	32	4,873,831	7,901,689	5,148,040	10,012,158	+ 6	1.62	1.94	25,125	403,640
Indiana	5	6	7,262,454	10,787,751	49	7,667,976	12,527,770	10,191,126	18,649,115	+33	1.63	1.83	448,451	1,047,960
Iowa	4	4	3,573,278	4,849,228	36	4,569,110	7,798,347	4,421,783	8,742,854	− 3	1.71	1.98	126,162	553,607
Kansas	7	7	2,927,270	4,340,794	48	3,023,901	5,467,284	4,158,399	8,649,157	+38	1.81	2.08	220,994	399,059
Michigan	11	11	4,675,244	4,891,457	5	4,990,308	8,468,196	4,442,455	10,939,633	−11	1.70	2.46	219,641	666,071
Missouri	5	5	5,216,347	6,017,517	15	5,496,164	9,264,017	5,605,952	10,980,453	+ 2	1.69	1.96	160,123	571,697
New York	8	9	4,383,579	5,885,058	34	4,441,250	7,700,406	6,049,150	12,206,698	+36	1.73	2.02	721,304	553,989
Ohio	5	5	1,637,418	1,780,433	9	1,821,597	3,311,179	1,670,958	3,561,490	− 8	1.82	2.13	82,468	197,521
Oklahoma	3	3	1,362,687	1,553,652	14	1,366,884	2,657,339	1,484,698	3,284,412	+ 9	1.94	2.21	71,908	134,438
Oregon and Washington	5	6	1,561,951	2,218,905	42	1,615,890	3,359,056	2,198,743	4,965,560	+36	2.08	2.26	227,648	247,809
Pennsylvania	21	21	25,325,173	28,269,314	12	26,250,077	43,126,528	27,662,116	52,632,082	+ 5	1.64	1.90	1,781,997	2,388,836
Texas	5	5	2,249,735	2,562,208	14	2,318,747	4,226,222	2,626,130	5,898,972	+13	1.82	2.25	205,918	143,502
Utah	3	3	819,861	1,093,741	33	935,305	1,906,816	1,022,639	2,314,413	+ 9	2.04	2.26	34,295	105,397
Other States [a]	17	19	10,933,341	13,136,545	20	11,498,523	20,159,799	12,565,520	26,152,383	+ 9	1.75	2.08	500,863	1,063,590
	111	117	80,777,935	100,023,245	24	85,612,899	146,734,844	96,311,719	194,439,025	+13	1.71	2.02	5,256,900	8,941,046

[a] Alabama, Colorado, Georgia, Kentucky, Maryland, Minnesota, Montana, Nebraska, New Jersey, Tennessee, Virginia, and West Virginia.

PRICES.

The average factory price of Portland cement per barrel in bulk in 1920 was $2.02, as compared with $1.71 in 1919. The price in 1920 is the highest for Portland cement that has been realized since 1892, when $2.11 per barrel was recorded. The lowest average price, $0.813, was recorded in 1909 and 1912.

CHROMITE.

SUPPLY.

Supplies of chromite in the United States, 1913 and 1915–1920.

Year.	Domestic shipments.		Imports.		Apparent consumption.[a]	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1913	255	$2,854	65,180	$622,821	65,435	$625,675
1915	3,281	36,744	76,455	780,061	79,736	816,805
1916	47,035	726,243	115,945	1,548,402	162,980	2,274,645
1917	43,725	1,049,400	72,063	1,110,659	115,788	2,160,059
1918	82,430	3,955,567	100,142	2,892,825	182,572	6,848,392
1919	5,079	129,302	61,404	1,381,497	66,483	1,510,799
1920	2,502	44,857	150,275	1,921,824	152,777	1,966,681

[a] There are no exports of chromite.

WORLD'S PRODUCTION.

Crude chromite produced by different countries, 1913 and 1915–1920, in metric tons.

Country.	1913	1915	1916	1917	1918	1919		1920
						Quantity.	Per cent of total.	
Canada [a]	.....	11,196	24,963	33,317	19,952	8,678	6	9,525
Cuba [b]	.....	.....	35	17	8,963	14,693	11	710
United States	259	3,334	47,790	44,427	83,753	5,161	4	2,542
Guatemala [b]	.....	.....	.....	182	1,212	1,686	1	1,122
Brazil [c]	.....	.....	.....	.....	18,141	4,877	4	3,451
Austria-Hungary [d]	305	(e)	(e)	12,600	(e)	(e)	.....	(e)
Great Britain [f]	113	.....	392	303	142	152	.....	(e)
Greece [g]	6,930	7,520	10,447	9,600	2,640	4,164	3	(e)
Russia [h]	15,000	15,000	15,000	(e)	.....	.....	.....	.....
India [i]	5,767	3,828	20,484	27,495	58,697	37,024	27	(e)
Japan [j]	1,326	2,989	8,278	8,941	6,247	6,012	4	(e)
Turkey (Asia Minor) [k]	14,000	14,000	14,000	(e)	(e)	3,500	3	25,000
Rhodesia [l]	57,500	54,958	80,622	66,190	28,382	32,007	23	54,674
Australia [m]	688	769	621	1,142	611	254	.....	(e)
New Caledonia [n]	63,370	57,474	74,715	41,892	26,000	20,000	14	60,000
Norway [o]	.....	350	2,757	3,975	(e)	(e)	.....	(e)
	165,258	171,418	300,104	250,081	254,740	138,208	100	[p]190,000

[a] Canada Dept. Mines, Mines Branch. 1913–1919, Ann. Rept. 1920, Prelim. Rept.
[b] Imports into U. S., Bur. Foreign and Domestic Commerce.
[c] 1918–1920, Imports into U. S., Bur. Foreign and Domestic Commerce.
[d] 1913, U. S. Geol. Survey Mineral Resources, 1918, pt. 1, p. 678. 1917, Min. Jour., London, Dec. 18, 1920. (Production from Hungary.)
[e] Figures not yet available.
[f] Great Britain. Mines and Quarries, General Repts., pt. 3.
[g] 1913–1917, Tableaux statistiques du mouvement minier de la Grèce. 1918–19, Information from U. S. consulate general, Athens, Greece, Aug. 31, 1920.
[h] Estimates. 1913–1916, U. S. Geol. Survey Mineral Resources 1918, pt. 1, p. 678. 1918–1920, This report.
[i] 1913–1918, India Geol. Survey Records. 1919, Preliminary statement by Director India Geol. Survey.
[j] 1913–1917, Résumé statisque de l'empire du Japon. 1918–19, Mining Industry, Japan Dept. Commerce, Bur. Mines.
[k] Estimates. 1913–1916, U. S. Geol. Survey Mineral Resources 1918, pt. 1, p. 678. 1919, This report. 1920, This report; on basis, largely, of information furnished by E. J. Lavino & Co., importers.
[l] 1913–1919, Report of Secretary for Mines, Rhodesia. 1920, Min. Jour., London, Jan. 27, 1921.
[m] New South Wales Dept. Mines Ann. Repts. Queensland, Ann. Repts. Undersecretary for Mines.
[n] 1913, Statisque de l'industrie minière dans les colonies françaises. 1915–1918, Mineral Industry, 1919. Figures except for 1915 are for exports. 1919–1920, Estimates, this report.
[o] Norges Bergverksdrift.
[p] Estimate.

IMPORTS.

Crude chromite imported into the United States, 1913 and 1915–1920, by countries, in long tons.

Country.	1913	1915	1916	1917	1918	1919	1920
Australia[a]	.....	.....	2,986	.....	15,976	13,161	2,778
Belgium	.....	.....	.....	.....	.....	.....	239
Brazil	.....	.....	.....	.....	17,854	4,800	3,451
British India	.....	.....	.....	.....	.....	.....	4,500
British South Africa[b]	.....	22,800	23,000	4,750	521	29	39,400
Canada	.....	10,087	12,220	19,012	20,949	8,941	8,491
Cuba	.....	.....	34	17	8,821	14,461	710
England	.....	2	5	5	4	.....	3,799
French Oceania[a]	21,850	28,031	30,950	10,300	25,761	7,125	50,314
Germany	.....	.....	.....	.....	.....	.....	1
Greece	4,600	4,305	7,900	.....	.....	.....	5,302
Guatemala	.....	.....	.....	179	1,193	1,659	1,122
Japan	79	.....	.....	.....	.....	.....	.....
New Zealand	.....	.....	.....	.....	.....	693	.....
Other British Oceania	.....	.....	.....	.....	1,063	.....	.....
Peru[a]	.....	.....	.....	.....	.....	.....	6,368
Portuguese Africa[b]	30,001	11,230	38,850	37,800	8,000	4,000	11,000
Spain	.....	.....	.....	.....	.....	3,035	40
Turkey in Asia	8,650	.....	.....	.....	.....	3,500	12,760
	65,180	76,455	115,945	72,063	100,142	61,404	150,275

[a] New Caledonia should be credited with most of the ore listed under Australia and all ore under French Oceania and Peru. (See figures of production for Australia.)
[b] Rhodesia should probably be credited with all ore listed under British South Africa and Portuguese Africa.

CLAY.

PRODUCTION.

Domestic clay marketed in the United States, 1913 and 1915–1920.

Year.	Kaolin.		Paper clay.		Slip clay.		Ball clay.		Fire clay.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	28,834	$235,457	126,377	$567,977	10,902	$24,505	67,134	$237,672	1,820,379	$2,592,591
1915	28,031	241,520	113,033	539,622	7,646	18,774	75,348	301,910	1,570,481	2,361,482
1916	47,723	306,819	153,434	768,911	14,064	47,939	89,761	391,152	2,057,814	3,708,009
1917	31,885	301,378	174,449	962,421	16,972	70,505	107,406	569,240	2,347,972	5,625,095
1918	37,969	391,109	141,725	1,068,420	13,552	49,898	89,896	590,631	2,305,033	5,664,064
1919	38,758	490,510	114,070	985,171	5,149	17,556	65,026	520,849	1,755,331	4,628,605
1920	[a] 268,203	[a] 2,865,407	(a)	(a)	9,006	41,519	69,477	584,611	2,341,076	7,425,674

Year.	Stoneware clay.		Brick clay.		Miscellaneous clay.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	153,353	$143,587	158,890	$137,976	282,120	$240,694	2,647,989	$4,180,459
1915	134,297	126,429	101,968	93,863	332,150	288,341	2,362,954	3,971,941
1916	135,958	137,779	97,164	76,854	336,672	314,311	2,932,590	5,751,774
1917	81,352	113,839	93,779	94,703	260,029	305,365	3,113,844	8,042,546
1918	86,800	147,098	(b)	(b)	301,386	421,421	2,976,361	8,332,641
1919	60,236	80,367	(b)	(b)	236,530	367,573	2,275,100	7,090,631
1920	106,350	229,221	(b)	(b)	322,100	467,856	3,116,212	11,614,288

[a] Paper clay included under "Kaolin."
[b] Included under "Miscellaneous clay."

IMPORTS.

Clay imported and entered for consumption in the United States, 1913 and 1915–1920.

Year.	Kaolin or china clay.			Common blue and Gross-Almerode glass-pot clay.		All other clays.				Total.	
						Unwrought.		Wrought.			
	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	268,666	$1,623,993	$6.04	24,986	$204,911	42,582	$155,693	1,889	$22,178	338,123	$2,006,775
1915	209,132	1,152,778	5.51	8,864	62,569	23,718	90,367	1,343	12,433	243,057	1,318,147
1916	253,707	1,326,684	5.23	2,501	12,134	42,478	163,421	180	1,994	298,866	1,504,233
1917	241,029	1,315,769	5.46	88	709	26,581	123,439	338	2,142	268,036	1,442,059
1918	168,100	1,153,240	6.86	114	983	26,984	163,484	137	1,087	195,335	1,318,794
1919	180,592	1,965,393	10.88	4	133	23,759	187,550	498	4,262	204,853	2,157,338
1920	361,800	3,568,677	9.86	6,837	157,201	34,252	272,524	691	10,267	403,580	4,008,669

EXPORTS.

Domestic clay exported from the United States, 1916–1920.[a]

Year.	Fire clay.		All other.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1916	45,752	$144,552	27,941	$145,970	73,693	$290,522
1917	54,023	268,093	29,194	178,764	83,217	446,857
1918	60,206	333,880	24,348	192,053	84,554	525,933
1919	37,486	262,501	30,983	249,571	68,469	512,072
1920	54,125	393,177	66,035	775,222	120,160	1,168,399

[a] Figures not available prior to 1916.

CLAY PRODUCTS.

PRODUCTION.

Value of the clay products of the United States, 1919 and 1920, by products.

Product.	1919	1920
Common brick	$63,584,748	$82,216,230
Vitrified brick or block	11,615,144	12,678,557
Face brick	16,033,059	19,440,968
Fancy or ornamental brick	77,879	71,081
Enameled brick	846,676	1,040,323
Draintile	10,945,943	12,524,641
Sewer pipe	16,754,832	25,371,015
Architectural terra cotta	3,988,182	10,851,902
Fireproofing and hollow building tile	17,964,573	27,112,007
Tile (not drain)	8,137,452	12,470,036
Stove lining	683,844	779,710
Fire brick	38,015,792	53,415,888
Miscellaneous	8,840,492	8,981,068
Total brick and tile	197,488,616	266,953,426
Total pottery	77,857,762	106,716,676
Grand total	275,346,378	373,670,102

IMPORTS.

Value of clay products imported and entered for consumption in the United States, 1913 and 1915–1920.

Year.	Pottery.								Brick, fire brick, tile, and miscellaneous clay products.	Grand total.
	Brown earthen and common stone ware.[a]	Tobacco pipes and pipe bowls of clay.	Earthenware and crockery composed of a nonvitrified absorbent body.		China and porcelain.		Sanitary earthenware decorated and not decorated.	Total.		
			Not decorated.	Decorated.	Not decorated.	Decorated.				
1913	$238,611	$31,806	[b] $81,978	[b] $523,803	[c] $1,067,209	[c] $8,273,681	.....	$10,217,088	$276,677	$10,493,765
1915	227,017	15,155	272,795	1,538,732	458,302	4,116,085	.....	6,628,086	171,801	6,799,887
1916	264,715	10,378	173,192	1,669,712	289,219	3,177,998	$15,371	5,600,585	165,080	5,765,665
1917	518,965	8,209	235,104	1,960,150	157,658	3,409,527	43,701	6,333,314	309,259	6,642,573
1918	436,207	4,716	317,501	2,147,486	200,328	3,269,008	18,334	6,393,580	290,620	6,684,200
1919	293,120	15,852	350,644	2,476,210	359,560	3,726,695	7,980	7,230,061	196,839	7,426,900
1920	390,962	12,091	340,676	3,805,955	431,636	5,856,384	13,068	10,850,772	419,098	11,269,870

[a] Including Rockingham ware and miscellaneous pottery products.
[b] Figures cover period from Oct. 4 to Dec. 31.
[c] Including wares classified under the act of 1913 as china and porcelain wares composed of a vitrified nonabsorbent body: Not decorated, $244,933; decorated, $2,204,851. Only wares composed of a vitrified nonabsorbent body are included after 1913.

EXPORTS.

Value of clay products of domestic manufacture exported from the United States, 1913 and 1915–1920.

Year.	Building brick.	Firebrick.	Tile (except drain).	Earthen and stone ware.	China.	Sanitary earthenware.	All other.	Total.
1913	$689,515	$1,121,590	$851,463	$410,050	$149,281	.....	$1,566,340	$4,788,239
1915	279,336	975,089	276,785	297,127	160,710	[a] $105,615	610,578	2,705,240
1916	189,668	2,406,184	403,184	600,377	262,119	214,076	779,922	4,855,530
1917	196,207	4,011,546	450,422	805,784	422,641	323,558	743,105	6,953,263
1918	117,263	5,001,057	582,051	783,577	318,448	377,527	752,651	7,932,574
1919	248,690	2,747,512	628,836	1,148,051	523,861	563,734	721,600	6,582,284
1920	382,814	4,200,266	1,025,083	1,241,938	816,817	778,714	951,991	9,397,623

[a] Figures cover period from July 1 to Dec. 31.

COAL.

PRODUCTION.

Coal produced in the United States, 1913 and 1915–1920.

Year.	Pennsylvania anthracite.		Bituminous.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	91,524,922	$195,181,127	478,435,297	$565,234,952	569,960,219	$760,416,079
1915	88,995,061	184,653,498	442,624,426	502,037,688	531,619,487	686,691,186
1916	87,578,493	202,009,561	502,519,682	665,116,077	590,098,175	867,125,638
1917	99,611,811	283,650,723	551,790,563	1,249,272,837	651,402,374	1,532,923,560
1918	98,826,084	336,480,347	579,385,820	1,491,809,940	678,211,904	1,828,290,287
1919	88,092,201	364,926,950	465,860,058	1,160,616,013	553,952,259	1,525,542,963
1920	89,598,249	434,252,000	568,212,683	2,127,141,000	657,810,932	2,561,393,000

Coal produced in the United States in 1919 and 1920, by States.

State.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alabama	15,536,721	$45,937,681	16,294,099	$59,410,000
Alaska	60,674	343,547	61,111	356,000
Arkansas	1,429,020	5,288,844	2,103,596	9,592,000
California and Idaho	6,554	22,174	2,753	12,000
Colorado	10,323,420	28,748,534	12,278,225	42,829,000
Georgia	53,337	198,033	50,156	251,000
Illinois	60,862,608	140,075,969	88,724,893	273,509,000
Indiana	20,912,288	46,345,750	29,350,585	92,867,000
Iowa	5,624,692	17,352,620	7,813,916	30,794,000
Kansas	5,224,724	15,917,053	5,926,408	22,923,000
Kentucky	30,036,061	73,891,049	35,690,762	146,576,000
Maryland	3,021,686	8,255,984	4,065,239	18,815,000
Michigan	996,545	3,864,228	1,489,765	7,346,000
Missouri	3,979,798	12,766,366	5,369,565	22,230,000
Montana	3,236,369	8,644,344	4,413,866	13,923,000
New Mexico	3,138,756	9,750,833	3,683,440	13,568,000
North Carolina	6,989	26,871	11,540	81,000
North Dakota	840,959	2,100,303	948,625	2,724,000
Ohio	35,876,682	79,496,301	45,878,191	175,081,000
Oklahoma	3,802,113	14,544,901	4,849,288	23,294,000
Oregon	18,739	63,794	20,717	93,000
Pennsylvania (bituminous)	150,758,154	365,430,504	170,153,847	639,838,000
South Dakota	14,417	45,707	12,777	46,000
Tennessee	5,213,205	14,448,168	6,662,428	26,778,000
Texas	1,680,656	4,527,640	1,615,015	6,062,000
Utah	4,631,323	12,760,613	6,005,199	19,350,000
Virginia	9,326,830	23,774,941	11,378,606	45,446,000
Washington	2,990,447	10,691,222	3,757,093	14,560,000
West Virginia	79,036,553	196,551,015	89,970,707	390,046,000
Wyoming	7,219,738	18,751,024	9,630,271	28,741,000
Total bituminous	465,860,053	1,160,616,013	568,212,683	2,127,141,000
Pennsylvania anthracite	88,092,201	364,926,950	89,598,249	434,252,000
Grand total	553,952,259	1,525,542,963	657,810,932	2,561,393,000

Anthracite produced in the United States in 1919 and 1920, by regions.

Region.	Shipments.		Sold to local trade and employees.		Mine fuel.		Total production.		Men employed.			Average number of days worked.
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Underground.	Surface.	Total.	
1919.												
Lehigh:												
Freshly mined coal	9,667,200	$48,227,896	403,574	$1,362,356	1,147,473	$2,048,182	11,218,247	$51,638,434	11,954	6,920	18,874	275
Washery product	717,686	2,475,112	2,701	5,057	48,163	101,463	768,550	2,581,632	.....	246	246	199
Dredge product	67,207	142,190	.....	.....	300	675	67,507	142,865	.....	44	44	155
	10,452,093	50,845,198	406,275	1,367,413	1,195,936	2,150,320	12,054,304	54,362,931	11,954	7,210	19,164	274
Average value per ton	$4.86		$3.37		$1.80		$4.51		.....	.....	.....	.....
Schuylkill:												
Freshly mined coal	17,897,847	91,308,502	368,840	1,821,962	3,074,679	2,439,193	21,341,366	95,569,657	30,224	15,340	45,564	266
Washery product	1,102,079	3,415,725	86	387	200,749	330,608	1,302,914	3,746,720	.....	1,556	1,556	117
Dredge product	248,354	282,125	279,274	398,809	6,280	10,644	533,908	691,578	.....	415	415	173
	19,248,280	95,006,352	648,200	2,221,158	3,281,708	2,780,445	23,178,188	100,007,955	30,224	17,311	47,535	259
Average value per ton	$4.94		$3.43		$0.85		$4.31		.....	.....	.....	.....
Wyoming:												
Freshly mined coal	36,694,081	193,871,715	1,031,398	4,724,884	3,443,843	5,413,284	41,169,322	204,009,883	65,087	20,980	86,067	268
Washery product	1,197,138	3,735,161	4,451	16,868	599,911	873,374	1,801,500	4,625,403	.....	949	949	173
Dredge product	8,128	16,418	8,742	16,787	548	1,098	17,418	34,303	.....	30	30	154
	37,899,347	197,623,294	1,044,591	4,758,539	4,044,302	6,287,756	42,988,240	208,669,589	65,087	21,959	87,046	267
Average value per ton	$5.21		$4.56		$1.55		$4.85		.....	.....	.....	.....
Sullivan County:												
Freshly mined coal	372,575	1,726,838	8,810	41,436	51,634	118,201	433,019	1,886,475	564	262	826	263
Average value per ton	$4.63		$4.70		$2.29		$4.36		.....	.....	.....	.....
Total freshly mined coal	64,631,703	335,134,951	1,812,622	7,950,638	7,717,629	10,018,860	74,161,954	353,104,449	107,829	43,502	151,331	268
Average value per ton	$5.19		$4.39		$1.30		$4.76		.....	.....	.....	.....
Total washery product	3,016,903	9,625,998	7,238	22,312	848,823	1,305,445	3,872,964	10,953,755	.....	2,751	2,751	145
Average value per ton	$3.19		$3.08		$1.54		$2.83		.....	.....	.....	.....
Total dredge product	323,689	440,733	288,016	415,596	7,128	12,417	618,833	868,746	.....	489	489	170
Average value per ton	$1.36		$1.44		$1.74		$1.40		.....	.....	.....	.....
Grand total	67,972,295	345,201,682	2,107,876	8,388,546	8,573,580	11,336,722	78,653,751	364,926,950	107,829	46,742	154,571	260
Average value per ton	$5.08		$3.98		$1.32		$4.64		.....	.....	.....	.....

Anthracite produced in the United States in 1919 and 1920, by regions—Continued.

Region.	Shipments.		Sold to local trade and employees.		Mine fuel.		Total production.	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1920.								
Lehigh:								
Freshly mined coal	9,177,704	$55,316,537	580,169	$1,958,945	1,185,446	$2,298,261	10,943,319	$59,573,743
Washery product	722,414	2,993,502	40,430	80,869	14,722	34,331	777,566	3,108,702
Dredge product	39,123	86,153	.....	.....	41	164	39,164	86,317
	9,939,241	58,396,192	620,599	2,039,814	1,200,209	2,332,756	11,760,049	62,768,762
Schuylkill:								
Freshly mined coal	18,628,633	111,309,896	451,326	2,627,580	3,246,184	2,792,189	22,326,143	116,729,665
Washery product	1,759,280	6,490,011	28	121	193,543	284,383	1,952,851	6,774,515
Dredge product	345,515	437,611	258,300	309,903	6,212	8,124	610,027	755,638
	20,733,428	118,237,518	709,654	2,937,604	3,445,939	3,084,696	24,889,021	124,259,818
Wyoming:								
Freshly mined coal	35,371,288	222,628,776	1,234,803	6,401,709	3,312,547	5,539,060	39,918,638	234,569,545
Washery product	2,133,820	8,200,962	11,018	42,979	794,010	1,861,713	2,938,848	10,105,654
Dredge product	11,928	20,341	.....	.....	.....	.....	11,928	20,341
	37,517,036	230,850,079	1,245,821	6,444,688	4,106,557	7,400,773	42,869,414	244,695,540
Sullivan County:								
Freshly mined coal	421,058	2,356,826	10,089	57,590	48,806	113,662	479,953	2,528,078
Total:								
Freshly mined coal	63,598,683	391,612,035	2,276,387	11,045,824	7,792,983	10,743,172	73,668,053	413,401,031
Washery product	4,615,514	17,684,475	51,476	123,969	1,002,275	2,180,427	5,669,265	19,988,871
Dredge product	396,566	544,105	258,300	309,903	6,253	8,288	661,119	862,296
Grand total	68,610,763	409,840,615	2,586,163	11,479,696	8,801,511	12,931,887	79,998,437	434,252,198

Anthracite shipped in 1919 and 1920, by regions and sizes, in long tons.

Size.	Lehigh region.			Schuylkill region.			Wyoming region.			Sullivan County.	Total.	Percentage of total.
	Mines.	Washeries.	Dredges.	Mines.	Washeries.	Dredges.	Mines.	Washeries.	Dredges.	Mines.		
1919.												
Lump	956			23,732			2,167				26,855	0.3
Broken	344,407	592		723,264			1,776,565	35		16,748	2,861,611	4.2
Egg	1,270,857	9,193		2,360,418	5,809		6,000,496	17,471		36,951	9,701,195	14.2
Stove	1,698,669	14,107		3,310,515	7,447		8,252,979	17,392		53,379	13,354,488	19.6
Chestnut	2,407,612	147,119		4,223,114	99,052	14	10,357,708	93,866		76,917	17,405,402	25.6
Pea	1,031,703	64,353	1,407	1,989,414	148,911	83	2,812,545	138,052	100	50,830	6,237,398	9.1
Buckwheat No. 1	1,485,358	93,748	7,394	2,995,157	336,729	2,900	4,514,899	365,214	260		9,801,659	14.4
Buckwheat No. 2	670,788	80,670	9,644	1,426,174	253,716	33,788	2,082,348	334,223	4,967		4,896,318	7.2
Buckwheat No. 3	425,283	240,057	48,762	746,297	219,735	127,815	473,662	102,610	2,765		2,386,986	3.5
Boiler	77,399	64,915		13,669	9,605	56,955	281,018	51,102			554,663	.8
Other [a]	254,168	2,932		86,093	21,075	26,799	139,694	77,173	36	137,750	745,720	1.1
	9,667,200	717,686	67,207	17,897,847	1,102,079	248,354	36,694,081	1,197,138	8,128	372,575	67,972,295	100.0
1920.												
Lump	1,024			28,041			4,259				33,324	.1
Broken	373,471	1,844		928,341			1,972,377	6,584		18,961	3,301,578	4.8
Egg	1,242,426	10,785		2,315,683	6,181		6,294,294	34,237		37,978	9,941,584	14.5
Stove	1,623,253	20,563		3,087,585	4,592		7,514,769	71,057		58,811	12,380,630	18.0
Chestnut	2,265,043	157,492		4,304,752	195,707	17	10,052,270	266,427		85,832	17,327,540	25.2
Pea	956,644	71,822	1,813	1,900,374	212,371	26	2,098,234	163,337	169	52,798	5,457,588	8.0
Buckwheat No. 1	1,328,694	74,570	3,745	3,195,618	451,284	8,463	3,773,327	331,867	366		9,167,934	13.4
Buckwheat No. 2	642,585	78,657	5,318	1,389,797	422,958	36,301	2,153,301	779,184	11,393		5,519,494	8.1
Buckwheat No. 3	563,158	301,320	28,247	1,131,456	394,555	164,974	1,089,468	273,139			3,946,317	5.6
Boiler	45,014			272,549	47,394	85,475	263,902	98,029			812,363	1.2
Other [a]	136,392	5,361		74,437	24,238	50,259	155,087	109,959		166,678	722,411	1.1
	9,177,704	722,414	39,123	18,628,633	1,759,280	345,515	35,371,288	2,133,820	11,928	421,058	68,610,763	100.0

[a] Includes quantity reported as culm, buckwheat No. 4, screenings, settlings, silt, mine run, dirt, and slush.

Value of anthracite shipped in 1919 and 1920, by regions and sizes.

1919.

Size.	Lehigh region.						Schuylkill region.					
	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.
Lump	$6,151	$6.43					$143,461	$6.04				
Broken	1,985,917	5.77	$3,233	$5.46			4,247,839	5.87				
Egg	7,782,583	6.12	55,565	6.04			14,466,017	6.13	$34,192	$5.89		
Stove	10,626,221	6.26	89,314	6.33			21,108,037	6.38	43,737	5.87		
Chestnut	15,316,403	6.36	934,994	6.35			27,172,172	6.43	628,171	6.34	$77	$5.50
Pea	5,059,829	4.90	322,897	5.02	$5,972	$4.24	9,726,784	4.89	722,191	4.85	465	5.60
Buckwheat No. 1	4,701,972	3.17	308,315	3.29	23,032	3.11	9,734,310	3.25	1,049,161	3.12	12,159	4.19
Buckwheat No. 2	1,554,067	2.32	212,036	2.63	25,034	2.60	3,328,285	2.33	573,807	2.26	39,738	1.18
Buckwheat No. 3	836,299	1.97	498,272	2.08	88,152	1.81	1,264,320	1.69	330,942	1.51	141,346	1.11
Boiler	176,543	2.28	46,986	.72			26,211	1.92	19,842	2.07	56,744	1.00
Other	181,911	.72	3,500	1.19			91,066	1.06	13,682	.65	31,596	1.18
	48,227,896	4.99	2,475,112	3.45	142,190	2.12	91,308,502	5.10	3,415,725	3.10	282,125	1.14

Size.	Wyoming region.						Sullivan County.		Total.	
	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.	Mines.	Average value.	Total.	Average value.
Lump	$13,794	$6.37							$163,406	$6.08
Broken	10,033,566	5.65	$203	$5.80			$102,222	$6.10	16,372,980	5.72
Egg	36,047,142	6.00	121,200	6.94			221,411	5.99	58,728,110	6.05
Stove	50,749,579	6.14	100,595	5.78			332,895	6.24	83,050,378	6.22
Chestnut	64,303,584	6.20	607,731	6.47			493,882	6.42	109,457,014	6.29
Pea	13,289,260	4.72	630,865	4.57	$474	$4.74	251,047	4.94	30,009,784	4.81
Buckwheat No. 1	13,053,539	2.89	991,884	2.72	837	3.22			29,875,209	3.05
Buckwheat No. 2	4,509,261	2.17	745,331	2.23	10,751	2.16			10,998,310	2.25
Buckwheat No. 3	890,813	1.88	193,150	1.88	4,336	1.57			4,247,630	1.78
Boiler	556,600	1.98	124,401	2.43					1,007,327	1.82
Other	424,577	3.04	219,801	2.85	20	.56	325,381	2.36	1,291,534	1.73
	193,871,715	5.28	3,735,161	3.12	16,418	2.02	1,726,838	4.63	345,201,682	5.08

1920.

Size.	Lehigh region.						Schuylkill region.					
	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.
Lump	$7,996	$7.81					$196,170	$6.99				
Broken	2,639,174	7.07	$12,379	$6.71			7,004,699	7.55				
Egg	9,210,337	7.41	77,197	7.16			17,304,675	7.47	$43,102	$6.97		
Stove	12,362,601	7.62	154,973	7.54			23,814,766	7.71	34,107	7.43		
Chestnut	17,296,056	7.64	1,151,691	7.31			33,388,549	7.76	1,542,871	7.88	$149	$8.76
Pea	5,473,221	5.72	424,316	5.91	$9,189	$5.07	11,021,435	5.80	1,213,887	5.72	132	5.08
Buckwheat No. 1	5,044,994	3.80	284,891	3.82	11,438	3.05	12,240,122	3.83	1,720,094	3.81	20,983	2.48
Buckwheat No. 2	1,945,220	3.03	237,468	3.02	15,379	2.89	3,679,530	2.65	1,130,020	2.67	59,553	1.64
Buckwheat No. 3	1,141,959	2.03	643,918	2.14	50,147	1.78	2,052,416	1.81	700,816	1.78	171,670	1.04
Boiler	118,021	2.62					556,889	2.04	93,168	1.97	110,755	1.30
Other	76,958	.56	6,669	1.24			50,645	.68	11,946	.49	74,369	1.48
	55,316,537	6.03	2,993,502	4.15	86,153	2.20	111,309,896	5.98	6,490,011	3.69	437,611	1.27

Value of anthracite shipped in 1919 and 1920, by regions and sizes—Continued.

1920—Continued.

Size.	Wyoming region.						Sullivan County.		Total.	
	Mines.	Average value.	Washeries.	Average value.	Dredges.	Average value.	Mines.	Average value.	Total.	Average value.
Lump	$40,051	$9.40							$244,217	$7.33
Broken	13,311,547	6.75	$44,880	$6.81			$158,714	$8.37	23,171,393	7.02
Egg	44,714,391	7.10	267,313	7.81			289,793	7.63	71,906,808	7.23
Stove	55,599,619	7.40	510,065	7.18			444,572	7.56	92,920,703	7.51
Chestnut	74,437,071	7.40	2,174,614	8.16			711,236	8.29	130,702,237	7.54
Pea	11,748,817	5.60	874,794	5.36	$372	$2.20	312,016	5.91	31,078,179	5.69
Buckwheat No. 1	13,899,789	3.68	1,192,886	3.59	821	2.21			34,416,018	3.75
Buckwheat No. 2	5,644,472	2.62	2,101,038	2.70	19,148	1.68			14,831,828	2.69
Buckwheat No. 3	2,205,862	2.02	535,827	1.96					7,502,615	1.90
Boiler	672,573	2.55	258,583	2.64					1,809,989	2.23
Other	354,584	2.28	240,962	2.19			440,495	2.64	1,256,628	1.74
	222,628,776	6.29	8,200,962	3.84	20,341	1.71	2,356,826	5.60	409,840,615	5.97

The year 1920 will be a memorable one in the history of the world's coal supply. The prices reached were the highest of modern times, and, as usually happens at such a time, the quality of the output deteriorated. In the last two years of the war the world's output had risen close to the pre-war level. After the armistice, however, the cessation of munitions manufacture and the delay in resumption of normal business curtailed the demand for coal. Industrial disputes both in Europe and America closed many mines late in 1919 and further reduced the supply. Thus, when in 1920 the world set its face to work again and industrial activity was resumed where resumption was possible, consumers' reserves of fuel proved insufficient, and an almost universal feeling of apprehension over the coal supply swept around the world. The reasons for this alarm—lately a thing of the past—become clear when the world's production in 1920 is cast up. Reports received by the United States Geological Survey indicate that the total output in 1920 was about 1,317,000,000 metric tons. This, although a great increase over 1919, was still 25,000,000 tons short of the output in 1913, the last year before the World War. The course of production during the last decade is shown in the following table:

World's production of coal, 1911–1920, by years, in metric tons.

Year.	Production (partly estimated).	United States per cent of total.	Year.	Production (partly estimated).	United States per cent of total.
1911	1,189,000,000	37.9	1916	1,296,000,000	41.4
1912	1,249,000,000	38.8	1917	1,345,000,000	44.0
1913	1,342,000,000	38.5	1918	1,331,000,000	46.2
1914	1,205,000,000	38.6	1919	1,170,000,000	42.9
1915	1,196,000,000	40.4	1920	1,317,000,000	45.3

World's production of coal in 1913 and 1920, by continents, in metric tons.

Continent.	1913	1920
North America	531,600,000	612,300,000
South America	1,600,000	1,800,000
Europe	730,000,000	604,400,000
Asia	55,800,000	71,000,000
Africa	8,300,000	11,200,000
Oceania	15,000,000	16,300,000
World	1,342,300,000	1,317,000,000

Coal produced in principal countries of the world in 1919 and 1920, in metric tons.

Country.		1919	1920
North America:			
Canada	Coal	9,756,019	11,812,871
	Lignite	2,655,309	3,275,304
Greenland		2,160	2,308
Mexico		693,866	(a)
United States (anthracite and bituminous, including lignite)		502,534,410	596,753,000
South America:			
Argentina		(a)	(a)
Brazil		(a)	(a)
Chile		1,334,789	1,060,585
Colombia		(a)	(a)
Peru		330,227	361,075
Venezuela		33,287	30,377
Europe:			
Austria	Coal	90,472	132,864
	Lignite	2,006,773	2,408,865
Belgium		18,482,880	22,388,770
Bulgaria		577,739	757,250
Czechoslovakia	Coal	9,865,605	11,143,221
	Lignite	17,081,208	19,943,258
France	Coal	21,546,000	24,300,000
	Lignite	895,000	1,000,000
Germany	Coal	b 116,707,200	b 140,757,433
	Lignite	93,645,500	111,634,000
Greece		182,951	182,880
Hungary		3,901,720	4,963,060
Italy c	Coal	d 1,317,923	151,862
	Lignite		1,571,735
Jugoslavia		2,497,394	3,224,324
Netherlands	Coal e	3,540,064	4,115,629
	Lignite	1,881,962	1,395,851
Norway		(a)	(a)
Poland		6,262,636	6,660,145
Portugal		146,341	169,165
Rumania		1,540,598	1,505,184
Russia		6,463,000	6,162,000
Spain	Coal	5,703,637	5,420,704
	Lignite	539,872	552,425
Spitzbergen		f 88,776	f 120,000
Sweden		429,267	439,584
Switzerland		64,902	74,590
United Kingdom		233,467,478	233,216,071
Asia:			
British India		22,991,217	17,356,889
China		18,292,252	19,484,896
Chosen		223,078	(a)
Federated Malay States		194,363	251,896
Indo-China		665,149	700,267
Japan (including Taiwan and Karafuto)		32,703,338	30,819,898
Russia		1,836,000	1,537,000
Turkey		481,331	g 700,000

a Figures not yet available. Estimate included in world total.
b Includes Saar basin.
c Includes new provinces.
d Includes bituminous shale.
e Includes slack.
f Shipments to Norway and Sweden.
g Based on incomplete data.

Coal produced in principal countries of the world in 1919 and 1920, in metric tons—Contd.

Country.	1919	1920
Africa:		
Algeria	7,419	7,793
Nigeria	140,057	183,013
Rhodesia (Southern)	462,698	524,796
Tunis	36,551	31,000
Union of South Africa	9,313,232	10,408,497
Oceania:		
Australia	10,736,321	13,176,426
British Borneo	(a)	(a)
Dutch East Indies	949,379	1,095,718
New Zealand	1,877,506	1,873,296
Philippine Islands	32,892	58,888
World	1,167,500,000	1,317,000,000

a Figures not yet available. Estimate included in world total.

IMPORTS.

Coal imported into the United States, 1913 and 1915–1920.

Year.	Anthracite.		Bituminous.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	1,031	$5,697	1,611,519	$3,856,811	1,612,550	$3,862,508
1915	3,357	14,922	1,703,785	4,398,425	1,707,142	4,413,347
1916	6,376	19,316	1,713,837	4,714,433	1,720,213	4,733,749
1917	12,530	46,523	1,448,453	4,795,110	1,460,983	4,841,633
1918	37,272	204,385	1,457,073	6,694,081	1,494,345	6,898,466
1919	82,818	522,419	1,011,550	4,950,686	1,094,368	5,473,105
1920	31,748	257,835	1,244,991	6,733,676	1,276,739	6,991,511

EXPORTS.

Coal exported from the United States, 1913 and 1915–1920.

Year.	Anthracite.		Bituminous.[a]		Total.[a]	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	4,652,912	$21,959,850	20,145,168	$45,449,664	24,798,080	$67,409,514
1915	3,965,255	18,429,255	18,776,640	42,817,341	22,741,895	61,246,596
1916	4,665,530	22,470,147	21,254,627	45,828,092	25,920,157	68,298,239
1917	6,007,306	30,909,798	23,839,558	79,502,654	29,846,864	110,412,452
1918	4,967,808	29,215,689	22,350,730	78,664,856	27,318,538	107,880,545
1919	4,976,598	36,668,131	20,113,536	83,708,842	25,090,134	120,376,973
1920	5,403,749	45,538,100	38,517,084	304,273,241	43,920,833	349,811,341

a Exclusive of bunker coal.

COBALT.

PRODUCTION.

In 1920 cobalt ores were mined only in Missouri, where the Missouri Cobalt Co. recovered 102,410 pounds of cobalt oxide and cobalt hydrate, valued at $262,801, from ore mined at its property near Fredericktown. The company operated only part of the year. In 1919 cobalt ores were mined in Idaho and Missouri. In Idaho the

Haynes Stellite Co. produced concentrates carrying approximately 18 per cent of cobalt, and in Missouri the Missouri Cobalt Co. shipped cobalt oxide mined and reduced at its property near Fredericktown. In 1918 cobalt ores were mined only in Idaho, where the Haynes Stellite Co. produced 55 tons of concentrates, carrying 17.74 per cent of cobalt (19,514 pounds), from 4,000 tons of ore.

IMPORTS.

Most of the cobalt used in this country has been imported from Canada, where it is obtained as a by-product from silver ores mined in the Cobalt district.

Cobalt, and cobalt ore, and zaffer, and cobalt oxide imported and entered for consumption in the United States, 1913 and 1915–1920.

Year.	Cobalt, and cobalt ore, and zaffer.		Cobalt, oxide of.		Total.	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
1913	164,119	$69,581	45,277	$26,154	209,396	$95,735
1915	53,375	70,283	154,672	148,828	208,047	219,111
1916	136,770	175,236	206,639	192,009	343,409	367,245
1917	223,794	369,950	276,406	275,821	500,200	645,771
1918	504,391	628,099	208,596	291,699	712,987	919,798
1919	77,556	144,282	131,424	184,751	208,980	329,033
1920	156,862	331,672	202,724	399,605	359,586	731,277

COKE.

PRODUCTION.

Coke produced in the United States, 1913 and 1915–1920.

Year.	By-product coke.				Beehive coke.				Total.	
	Quantity.		Value.		Quantity.		Value.		Quantity (short tons).	Value.
	Short tons.	Percentage of total.	Amount.	Percentage of total.	Short tons.	Percentage of total.	Amount.	Percentage of total.		
1913	12,714,700	27.5	$48,637,852	37.7	33,584,830	72.5	$80,284,421	62.3	46,299,530	$128,922,273
1915	14,072,895	33.8	48,558,325	46.0	27,508,255	66.2	56,945,543	54.0	41,581,150	105,503,868
1916	19,069,361	35.0	75,373,070	44.1	35,464,224	65.0	95,468,127	55.9	54,533,585	170,841,197
1917	22,439,280	40.4	138,643,153	46.5	33,167,548	59.6	159,599,864	53.5	55,606,828	298,243,017
1918	25,997,580	46.0	193,018,785	50.5	30,480,792	54.0	189,305,583	49.5	56,478,372	382,324,368
1919	25,137,621	56.9	160,244,768	62.0	19,042,936	43.1	98,094,972	38.0	44,180,557	258,339,740
1920	30,833,951	60.0	313,028,732	63.3	20,511,092	40.0	181,217,522	36.7	51,345,043	494,246,254

Statistics of the manufacture of coke in the United States, 1913 and 1915–1920.

Year.	In operation.		Coal used (short tons).	Percentage yield of coke from coal.	Coke produced (short tons).	Total value of coke at ovens.	Average price of coke per ton at ovens.
	Establishments.	Ovens.					
1913	444	72,008	69,239,190	66.9	46,299,530	$128,922,273	$2.78
1915	354	54,967	61,832,898	67.2	41,581,150	105,503,868	2.54
1916	389	72,888	81,609,460	66.8	54,533,585	170,841,197	3.13
1917	398	75,985	83,752,371	66.4	55,606,828	298,243,017	5.36
1918	403	70,221	85,028,018	66.4	56,478,372	382,324,368	6.77
1919	373	47,215	65,587,918	67.4	44,180,557	258,339,740	5.85
1920	[a] 416	[a] 86,179	76,190,832	67.3	51,345,043	494,246,254	9.62

[a] Total in existence. Statistics of idle plants not available.

By-product coke produced in the United States, 1919 and 1920, by States.

State.	1919		1920	
	Total ovens.	Coke produced (short tons).	Total ovens.	Coke produced (short tons).
Alabama	906	2,230,933	1,081	3,123,890
Colorado	120	412,863	120	516,673
Illinois	714	1,703,903	794	2,136,793
Indiana	1,216	3,702,180	1,216	4,553,697
Kentucky	108	408,278	108	466,985
Maryland	300	356,237	300	682,132
Massachusetts	400	393,331	400	488,089
Michigan	389	808,729	389	1,393,445
Minnesota	220	586,094	220	674,801
Missouri	56	(a)	56	(a)
New Jersey	315	788,465	315	725,571
New York	615	751,067	732	1,040,192
Ohio	1,608	5,374,027	1,558	5,614,877
Pennsylvania	2,846	5,866,841	3,006	7,730,256
Rhode Island	40	(a)	40	(a)
Tennessee	24	104,749	24	139,121
Washington	20	26,547	20	26,284
West Virginia	214	392,812	274	447,392
Wisconsin	268	(a)	228	(a)
Combined States	.....	1,230,565	.....	1,073,753
	10,379	25,137,621	10,881	30,833,951

[a] Included under "Combined States."

By-product coke produced and sold or used by the producer in the United States, 1919 and 1920, by States and kinds.

State.	Production.		Coke sales.						Coke used by producer (short tons).
			Furnace.		Foundry.		Domestic and other.		
	Coke (short tons).	Screenings and breeze (short tons).	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	
Alabama	3,123,890	206,847	228,798	$1,890,345	27,514	$301,000	21,300	$115,428	2,836,509
Illinois	2,136,793	197,746	387,790	5,008,243	216,537	3,040,733	267,755	2,479,078	1,259,168
Indiana	4,553,697	326,546	180,718	2,120,703	196,208	2,667,306	385,842	3,083,628	3,840,900
Kentucky	466,985	42,283	364,266	2,623,676	44,098	501,462	64,278	534,466	
Maryland	682,132	50,360	7,437	(a)					678,989
Massachusetts	488,089	33,150			355,365	(a)	132,410	(a)	
Michigan	1,393,445	92,388	291,793	3,227,253	400,696	5,553,922	448,752	4,107,026	282,799
Minnesota	674,801	45,504	106,085	1,127,699	57,229	744,511	163,765	1,719,202	360,806
New Jersey	725,571	72,330	453,831	(a)	95,164	(a)	221,837	(a)	10,683
New York	1,040,192	38,980	297,628	3,471,321	8,036	99,003	90,220	1,022,880	639,445
Ohio	5,614,877	423,887	651,654	6,547,341	632	4,418	169,216	1,135,150	4,783,002
Pennsylvania	7,730,256	777,027	544,152	6,291,166			173,763	941,251	7,100,823
Tennessee	139,121	5,141	98,677	900,300	39,702	460,490			
Washington	26,284	6,014	1,057	10,993					23,344
West Virginia	447,392	7,512	36,348	397,569			9,110	70,989	344,957
Combined States:									
Colorado, Missouri, Rhode Island, Wisconsin	1,590,426	135,120	404,730	[b] 9,224,613	274,801	[c] 10,305,380	213,489	[c] 5,871,331	687,036
Total, 1919	30,833,951	2,460,835	4,054,964	42,841,222	1,715,982	23,678,225	2,361,737	21,080,429	22,848,461
	25,137,621	1,848,547	4,677,497	31,028,251	1,480,516	12,865,927	2,885,270	15,607,752	17,767,066

[a] Included under "Combined States."
[b] Includes also value for Maryland and New Jersey.
[c] Includes also value for Massachusetts and New Jersey.

Beehive coke produced in the United States, 1919 and 1920, by groups of States, in short tons.

Groups of States.	1919	1920
Pennsylvania and Ohio	14,743,000	15,996,000
West Virginia	1,021,000	1,381,000
Alabama, Tennessee, and Georgia	1,324,000	1,069,000
Virginia and Kentucky	1,214,000	1,300,000
Colorado, Oklahoma, and New Mexico	479,000	512,000
Washington and Utah	262,000	253,000
	19,043,000	20,511,000

Beehive coke produced in the United States, 1919 and 1920, by months, in short tons.[a]

Month.	1919	1920
January	2,366,000	1,946,000
February	1,767,000	1,705,000
March	1,714,000	1,976,000
April	1,277,000	1,579,000
May	1,101,000	1,671,000
June	1,143,000	1,683,000
July	1,457,000	1,666,000
August	1,681,000	1,749,000
September	1,736,000	1,731,000
October	1,504,000	1,716,000
November	1,629,000	1,605,000
December	1,668,000	1,484,000
	19,043,000	20,511,000

[a] Monthly distribution estimated on basis of railroad shipments. Annual total revised to agree with the production as reported by operators.

IMPORTS AND EXPORTS.

Coke imported into and exported from the United States, 1913 and 1915–1920.

Year.	Imports for consumption.		Exports.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	101,212	$435,157	987,395	$3,309,930
1915	53,222	222,382	895,509	3,092,498
1916	54,955	249,514	1,174,645	4,202,236
1917	24,872	146,451	1,409,320	8,543,746
1918	30,168	221,880	1,687,824	11,861,408
1919	16,486	140,653	716,956	5,128,119
1920	41,143	403,175	919,802	9,993,665

COKE-OVEN BY-PRODUCTS.

PRODUCTION.

By-products from coke-oven operations in the United States in 1919 and 1920.

Product.	Production.	Sales.	
		Quantity.	Value.
1919.			
Tar.....gallons..	288,901,739	217,707,157	$6,918,549
Ammonia:			
Sulphate.....pounds..	544,303,827	557,492,773	21,058,744
Anhydrous or free ammonia [a].....do....	50,535,639	51,646,744	5,692,950
Sulphate equivalent.....do....	746,446,383	764,079,749	26,751,694
Gas:			
Illuminating and household purposes.....M cubic feet..	415,655,098	5,238,486	2,106,806
Industrial purposes.....do....		138,121,007	8,078,442
To public service corporations.....do....		49,464,601	6,464,947
	415,655,098	192,824,094	16,650,195
Benzol products:			
Crude light oil.....gallons..	92,473,409		
Benzol {crude [b].....do....	44,060,970	44,673,554	7,860,093
Benzol {refined.....do....	17,006,532	18,403,909	3,783,552
Toluol {crude.....do....			
Toluol {refined.....do....	1,160,136	1,353,827	355,990
Solvent naphtha.....do....	3,920,489	3,625,978	552,853
Other refined oils.....do....	575,885	127,483	18,358
	66,724,012	68,184,751	12,570,846
Naphthalene {crude.....pounds..	3,579,998	4,038,455	82,244
Naphthalene {refined.....do....	2,763,271	2,663,585	109,120
	6,343,269	6,702,040	191,364
Other products [c]			645,142
1920.			
Tar.....gallons..	360,664,124	174,363,696	6,378,040
Ammonia:			
Sulphate.....pounds..	675,816,486	626,013,975	27,110,260
Anhydrous or free ammonia [a].....do....	65,777,259	62,076,772	8,585,173
Sulphate equivalent.....do....	938,925,522	874,321,063	35,695,433
Gas:			
Distributed through city mains.....M cubic feet..	476,485,744	53,220,824	15,716,888
Used in steel or affiliated plant.....do....		151,764,807	14,301,095
Used under boilers, etc.....do....		25,430,288	2,216,335
	476,485,744	230,415,919	32,234,318
Light oil and derivatives:			
Crude light oil.....gallons..	109,709,915	1,067,045	126,158
Benzol {crude.....do....	8,747,572	1,510,420	401,296
Benzol {refined.....do....	16,977,556	15,720,356	4,096,527
Motor fuel.....do....	57,645,462	55,764,265	12,644,931
Toluol {crude.....do....	287,142		
Toluol {refined.....do....	2,710,649	2,470,364	740,722
Solvent naphtha.....do....	5,678,525	4,695,464	851,048
	92,046,906	81,227,914	18,860,682
Naphthalene {crude.....pounds..	11,246,807	11,507,703	307,999
Naphthalene {refined.....do....	2,921,282	2,941,059	179,975
	14,168,089	14,448,762	487,974
Other products [d]			36,317

[a] Includes liquor and sulphate sold on pound basis of NH_3.
[b] Mainly motor fuel containing varying percentages of other constituents.
[c] Sodium ferrocyanide, retort carbon, residue, coal-tar paint, sodium prussiate, extil covering, crude heavy solvent, and ammonium chloride.
[d] Includes coal-tar oil, crude heavy solvent, carbon, and pyridin oil.

COPPER.

SUMMARY OF STATISTICS.

Summary of statistics of the copper industry in the United States, 1913–1920.

	1913	1914	1915	1916
Production of copper:				
Smelter output.....pounds..	1,224,484,098	1,150,137,192	1,388,009,527	1,927,850,548
Mine production.....do....	1,235,569,727	1,148,431,437	1,488,071 528	2,005,875,312
Refinery production of new copper—				
Electrolytic.....pounds..	1,022,497,601	991,573,073	1,114,345,342	1,579,620,513
Lake.....do....	155,715,286	158,009,748	236,757,062	269,794,531
Casting and pig.....do....	58,611,026	60,840,368	36,603,119	39,337,155
Total domestic.....do....	1,236,823,913	1,210,423,189	1,387,705,523	1,888,752,199
Total domestic and foreign.....do....	1,615,067,782	1,533,781,394	1,634,204,448	2,259,387,315
Total new and old copper.....do....	1,888,000,000	1,790,000,000	2,027,000,000	2,959,000,000
Total ore produced.....short tons..	36,361,101	35,187,118	43,415,133	57,953,357
Copper ore produced.....do....	36,336,682	35,175,541	43,404,182	57,863,365
Average yield of copper.....per cent..	1.67	1.60	1.66	1.70
Average price per pound.....cents..	15.5	13.3	17.5	24.6
Imports (unmanufactured).....pounds..	408,778,954	306,350,827	315,698,449	462,335,980
Exports of metallic copper [a].....do....	926,241,092	840,080,922	681,917,855	784,006,486
Withdrawn from total supply on domestic account:				
Total new copper.....do....	812,268,639	701,624,158	1,136,618,187	1,478,881,871
Total new and old copper.....do....	1,085,000,000	958,000,000	1,529,000,000	2,179,000,000
World's production.....do....	2,181,253,000	2,054,090,000	2,377,375,000	2,998,679,000
Value of production in the United States.....	$189,795,035	$152,968,000	$242,902,000	$474,288,000

	1917	1918	1919	1920
Production of copper:				
Smelter output.....pounds..	1,886,120,721	1,908,533,595	1,286,419,329	1,209,061,040
Mine production.....do....	1,895,434,349	1,910,022,841	1,212,334,041	1,224,550,151
Refinery production of new copper—				
Electrolytic.....pounds..	1,452,744,593	1,560,327,422	1,233,994,324	1,010,240,867
Lake.....do....	268,508,091	231,096,158	177,594,135	153,483,952
Casting and pig.....do....	152,293,487	91,450,611	21,897,336	18,698,421
Total domestic.....do....	1,873,546,171	1,882,874,191	1,433,485,795	1,182,423,240
Total domestic and foreign.....do....	2,428,546,171	2,432,385,230	1,805,306,801	1,634,908,644
Total new and old copper.....do....	3,195,000,000	3,138,000,000	2,380,000,000	2,260,000,000
Total ore produced.....short tons..	58,514,325	62,304,767	36,139,254	36,792,260
Copper ore produced.....do....	58,482,694	62,289,069	36,121,622	36,765,370
Average yield of copper.....per cent..	1.60	1.51	1.65	1.63
Average price per pound.....cents..	27.3	24.7	18.6	18.4
Imports (unmanufactured).....pounds..	556,420,297	575,805,115	429,387,594	485,670,691
Exports of metallic copper [a].....do....	1,125,647,336	744,243,481	515,595,019	623,158,489
Withdrawn from total supply on domestic account:				
Total new copper.....do....	1,394,829,715	1,661,669,576	914,471,572	1,053,838,558
Total new and old copper.....do....	2,162,000,000	2,367,000,000	1,489,000,000	1,679,000,000
World's production.....do....	3,149,185,000	3,158,592,000	(b)	(b)
Value of production in the United States.....	$514,911,000	$471,408,000	$239,274,000	$222,467,000

[a] Total exports of copper, exclusive of ore, concentrates, and composition metal.
[b] Figures not yet available.

PRODUCTION.

Copper produced in the United States from domestic ores, 1913 and 1915–1920.

[Smelter output, in pounds fine.]

State.	1913	1915	1916	1917	1918	1919	1920
Alaska	23,423,070	70,695,286	113,823,064	84,759,086	67,081,648	56,534,992	66,093,924
Arizona	404,278,809	432,467,690	694,847,307	719,035,514	769,521,729	536,515,368	552,988,731
California	32,492,265	37,658,444	43,400,876	44,933,846	44,150,761	23,548,698	11,822,028
Colorado	9,052,104	7,272,178	9,536,193	10,054,951	7,591,570	4,892,558	4,282,616
Georgia	.....	.....	803,699	930,691	397,078	8,306	3,663
Idaho	8,711,490	6,217,728	7,248,794	6,446,224	5,836,795	3,966,655	1,922,116
Maine	.....	.....	.....	34,872	501,169	376,186	.....
Maryland	.....	15,426	126,965	291,501	.....	.....	.....
Michigan	155,715,286	238,956,410	269,794,531	268,508,091	231,096,158	177,594,135	153,483,952
Missouri	576,204	306,406	377,575	407,141	232,073	588,570	533,368
Montana	285,724,467	268,263,040	352,139,768	276,225,977	326,426,761	176,289,873	177,743,747
Nevada	85,209,536	67,757,322	100,816,724	115,028,161	106,266,603	64,683,734	55,580,322
New Jersey	.....	.....	4,115	.....	.....	.....	.....
New Mexico	50,196,881	62,817,234	79,863,439	107,593,615	96,559,580	60,377,320	52,159,751
North Carolina	180	33,383	5,961	125,004	79,200	3,334	.....
Oregon	77,812	797,471	2,433,567	1,105,097	2,630,499	2,808,017	2,529,311
Pennsylvania	245,337	.....	904	115,000	34,500	.....	618,361
South Carolina	.....	.....	.....	210,000	.....	2,297	.....
South Dakota	.....	.....	.....	.....	.....	8,631	2,190
Tennessee	19,489,654	18,205,308	14,556,278	16,093,757	15,053,568	15,629,454	16,727,803
Texas	39,008	38,971	86,463	2,061,129	13,851	2,153	14,217
Utah	148,057,450	175,177,695	232,335,950	227,840,447	230,964,908	143,836,304	110,357,748
Vermont	5,771	23,995	324,400	102,522	896,630	582,561	.....
Virginia	46,961	50,008	1,066,143	146,912	1,248	.....	.....
Washington	732,742	903,661	2,473,481	2,051,416	2,330,568	2,552,134	2,125,586
Wyoming	362,235	351,871	1,784,351	2,019,767	866,698	150,051	24,256
Undistributed	46,836	.....	.....	.....	.....	15,467,998	47,350
	1,224,484,098	1,388,009,527	1,927,850,548	1,886,120,721	1,908,533,595	1,286,419,329	1,209,061,040

Primary and secondary copper produced by regular refining plants in the United States and imported, 1913–1920, in pounds.

	1913	1914	1915	1916
Primary:				
Domestic:[a]				
Electrolytic	1,022,497,601	991,573,073	1,114,345,342	1,579,620,513
Lake	155,715,286	158,009,748	[b] 236,757,062	269,794,531
Casting	22,606,040	21,506,325	21,555,129	12,469,050
Pig and best select	36,004,986	39,334,043	15,047,990	26,868,105
	1,236,823,913	1,210,423,189	1,387,705,523	1,888,752,199
Foreign (electrolytic)[a]	378,243,869	323,358,205	246,498,925	370,635,116
	1,615,067,782	1,533,781,394	1,634,204,448	2,259,387,315
Secondary:				
Electrolytic	14,862,577	27,702,928	38,156,789	78,585,296
Casting	22,360,182	4,224,052	21,417,901	25,838,511
	37,222,759	31,926,980	59,574,690	104,423,807
Total output	1,652,290,541	1,565,708,374	1,693,779,138	2,363,811,122

[a] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

[b] Some Lake copper was refined at seaboard plants and doubtless marketed under some brand other than Lake. This has been excluded from the Lake copper.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1913–1920, in pounds—Continued.

	1917	1918	1919	1920
Primary:				
Domestic: [a]				
Electrolytic	1,452,744,593	1,560,327,422	1,233,994,324	1,010,240,867
Lake	268,508,091	231,096,158	177,594,135	153,483,952
Casting	69,916,911	15,284,635	18,223,145	13,905,114
Pig and best select	82,376,576	76,165,976	3,674,191	4,793,307
	1,873,546,171	1,882,874,191	1,433,485,795	1,182,423,240
Foreign: [a]				
Electrolytic	[b] 555,000,000	[b] 492,181,364	[b] 370,558,779	[b] 450,194,958
Casting and best select		57,329,735	1,262,227	2,290,446
	2,428,546,171	2,432,385,290	1,805,306,801	1,634,908,644
Secondary:				
Electrolytic	66,337,771	34,674,062	32,408,548	32,856,549
Casting	12,779,125	9,018,049	38,876,481	49,130,510
	79,116,896	43,692,111	71,285,029	81,987,059
Total output	2,507,663,067	2,476,077,401	1,876,591,830	1,716,895,703

[a] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.
[b] Includes refined copper imported.

In addition to their output of metallic copper the regular refining companies produced in 1920 bluestone having a copper content of 7,823,000 pounds, as compared with 7,883,000 pounds in 1919.

STOCKS.

Stocks of refined copper in the United States, Jan. 1, 1917–1921.

	Pounds.
Jan. 1, 1917	128,000,000
Jan. 1, 1918	114,000,000
Jan. 1, 1919	180,000,000
Jan. 1, 1920	631,000,000
Jan. 1, 1921	659,000,000
Increase in 1920	28,000,000

In addition to the stocks of refined copper on hand January 1, 1921, 465,000,000 pounds of blister copper and material in process of refining was reported as at smelters in the United States, in transit from smelters to refiners, and at refineries, against 273,000,000 pounds on January 1, 1920.

CONSUMPTION.

Apparent consumption[a] of refined new copper in the United States, 1913–1920, in pounds.

	1913	1914	1915	1916
Total supply of new copper	1,615,067,782	1,533,781,394	1,634,204,448	2,259,387,315
Stocks at beginning of year	105,497,683	90,385,402	173,640,501	82,429,666
Total available supply	1,720,565,465	1,624,166,796	1,807,844,949	2,341,816,981
Copper exported [b]	817,911,424	748,902,137	588,797,096	734,879,881
Stocks at end of year	90,385,402	173,640,501	82,429,666	128,055,229
Total withdrawn from supply	908,296,826	922,542,638	671,226,762	862,935,110
Apparent consumption [a]	812,268,639	701,624,158	1,136,618,187	1,478,881,871

[a] Withdrawn from total year's supply on domestic account.
[b] Includes unrefined black blister and converter copper (bars, pigs, and other forms) and refined in ingots, bars, rods, or other forms.

Apparent consumption[a] of refined new copper in the United States, 1913–1920, in pounds—Continued.

	1917	1918	1919	1920
Total supply of new copper	2,428,546,171	2,432,385,290	1,805,306,801	1,634,908,644
Stocks at beginning of year	128,055,229	114,000,000	180,000,000	631,000,000
Total available supply	2,556,601,400	2,546,385,290	1,985,306,801	2,265,908,644
Copper exported[b]	1,047,771,685	704,715,714	439,835,229	553,070,086
Stocks at end of year	114,000,000	180,000,000	631,000,000	659,000,000
Total withdrawn from supply	1,161,771,685	884,715,714	1,070,835,229	1,212,070,086
Apparent consumption[a]	1,394,829,715	1,661,669,576	914,471,572	1,053,838,558

[a] Withdrawn from total year's supply on domestic account.
[b] Includes unrefined black blister and converter copper (bars, pigs, and other forms) and refined in ingots, bars, rods, or other forms.

IMPORTS.

Copper imported into the United States, 1919 and 1920, in pounds.

1919.

Country.	Ore (copper content).	Concentrates (copper content).	Matte and regulus (copper content).	Unrefined black copper and copper in bars, pigs, or other forms.	Refined in bars, plates, rods, or other forms.	Old and clippings for remanufacture.	Composition metal, copper chief value.
United Kingdom			201,706	228,083	224,000		223,689
Spain	2,157,072					2,000	
Canada	24,487,478	1,608,378	2,105,357	31,199,467	1,860,609	3,612,020	22,412
Mexico	918,091	27,600,065	28,852,151	52,609,210	12,467,393	6,954	
Chile	7,636,963	1,456,571	6,407,432	89,859,898	20,449,718		
Cuba	11,107,064	3,947,226	925,295	363		362,898	11,061
Peru	1,165,768		304,530	80,829,505		16,799	
Japan				600			
Other countries	2,244,075	1,800,840	1,529,001	8,493,323	137,040	216,669	98,820
	49,716,511	36,413,080	40,325,472	263,220,449	35,138,760	4,217,340	355,982

1920.

United Kingdom	1,256,948		71,982	5,939,811	1,437,027	4,830,953	2,148,843
France	41,842		76,109	3,073,425	3,258,043	4,822,375	54,092
Germany			617,940	130,957	60	806,041	566,625
Spain	2,123,594				1,194,975		
Canada	22,022,211	2,922,633	3,611,518	26,287,350	750,916	883,614	132,255
Mexico	883,716	25,931,336	7,361,140	72,670,790		5,648	
Cuba	7,786,690	10,659,959				61,387	
Chile	9,668,396	4,559,655	4,282,856	46,289,793	101,000,138	6,722	23,850
Peru	1,064,501	148,401	863,328	82,509,806			
Japan							
Other countries	7,197,393	2,575,606	709,301	7,794,392	1,102,139	141,627	1,309,982
	52,045,291	46,797,590	17,594,174	244,696,324	108,743,298	11,558,367	4,235,647

EXPORTS.

Copper exported from the United States, 1918–1920, in pounds.

	1918	1919	1920
Ore (copper content)	2,387,275	507,846	248,712
Concentrates (copper content)	872,564	160,821	192,194
Unrefined black blister and converter copper (bars, pigs, and other forms)	14,687,823	1,674,411	1,843,293
Refined ingots, bars, rods, or other forms	690,027,891	438,160,818	551,226,793
Composition metal, copper chief value	186,260	364,089	454,306
Old and scrap	257,403	449,804	577,319
Pipes and tubes	4,109,226	5,993,959	4,899,223
Plates and sheets	19,471,584	13,764,425	22,799,148
Wire	15,689,554	55,551,602	41,812,713
	747,689,580	516,627,775	624,053,701

PRICES.

[See statement on page 16a.]

CORUNDUM.

[See under Abrasive materials.]

CRYOLITE.

PRODUCTION.

No natural cryolite is produced in the United States, the entire supply used in this country being imported from Greenland.

IMPORTS.

Cryolite imported and entered for consumption in the United States, 1911–1920.

Year.	Quantity (long tons).	Value.	Average price per ton.	Year.	Quantity (long tons).	Value.	Average price per ton.
1911	2,007	$47,093	$23.46	1916	3,857	$165,222	$42.84
1912	2,126	48,293	22.72	1917	4,383	218,500	49.86
1913	2,559	52,557	20.54	1918	1,950	97,500	50.00
1914	4,612	94,424	20.47	1919	2,131	106,956	50.19
1915	3,940	82,750	21.00	1920	3,864	193,638	50.11

DIATOMACEOUS (INFUSORIAL) EARTH.

[See under Abrasive materials.]

EMERY.

[See under Abrasive materials.]

FELDSPAR.

PRODUCTION.

Feldspar sold by producers in the United States, 1911–1920

Year.	Quantity (short tons).	Value.		Year.	Quantity (short tons).	Value.	
		At price for crude spar.	As sold (crude and ground).			At price for crude spar.	As sold (crude and ground).
1911	92,700	$269,546	$579,008	1916	132,681	$404,689	$702,278
1912	86,572	269,511	520,562	1917	141,924	474,767	728,838
1913	120,955	369,348	776,551	1918	99,120	429,989	674,346
1914	135,419	399,069	629,873	1919	71,054	347,992	585,200
1915	105,118	336,667	489,223	1920	151,817	851,123	1,508,990

Feldspar produced and sold in Canada, 1911–1920.[a]

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	17,723	$51,939	1916	19,488	$71,407
1912	13,733	30,916	1917	19,462	89,826
1913	15,935	56,841	1918	18,782	112,728
1914	18,060	70,824	1919	14,679	86,231
1915	15,455	59,124	1920	36,856	274,075

[a] Report on mineral production of Canada, Canada Dept. Mines.

IMPORTS AND EXPORTS.

The United States imports nearly the whole of the Canadian production of feldspar and none from other countries. Imports and exports are not specifically shown by the Bureau of Foreign and Domestic Commerce.

FERROALLOYS.

PRODUCTION.[a]

Ferroalloys of domestic manufacture shipped from furnaces in the United States, 1913 and 1915–1920, in long tons.[a]

Year	Ferro-manganese.	Spiegel-eisen.	Other varieties.	Total quantity.	Total value.
1913	119,495	106,980	69,732	296,207	$13,015,362
1915	144,260	114,556	129,828	388,644	17,450,385
1916	224,103	182,837	182,798	589,738	50,281,692
1917	260,225	189,241	184,555	634,021	83,731,724
1918	306,076	263,861	180,931	750,868	115,433,943
1919	198,255	90,855	130,528	419,638	53,730,964
1920	276,594	103,672	232,542	612,808	77,519,367

[a] Prior to 1919, the figures fall short of the actual production of the United States, as the output of certain electrically produced ferroalloys is not available for publication by the Geological Survey.

Ferroalloys shipped from furnaces in the United States, 1919 and 1920.

Variety of alloy.	1919		1920	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.
Ferromanganese	198,255	$27,093,816	276,594	$41,840,690
Spiegeleisen	90,855	3,965,754	103,672	5,289,049
Ferrosilicon (7 per cent or more silicon)	103,244	5,973,398	193,580	11,634,650
Ferrophosphorus	6,706	714,339	18,935	2,129,657
Ferrotitanium	(a)	(a)		
Ferrochromium	15,763	5,106,442	16,606	5,708,277
Ferrovanadium	1,485	5,487,138	2,290	9,074,648
Ferromolybdenum	(a)	(a)	21	47,873
Ferrotungsten (65 per cent or more tungsten)	1,298	3,852,740	1,084	1,623,710
Other varieties b	2,032	1,537,337	26	170,813
	419,638	53,730,964	612,808	77,519,367

a Included under "Other varieties."
b 1919: Ferromolybdenum, ferrotitanium, and ferrozirconium; 1920: Ferrocerium, ferrotantalum-columbium, ferrouranium, and ferrozirconium.

IMPORTS.

Ferroalloys imported for consumption in the United States, 1918–1920.

Variety of alloy.	1918		1919		1920	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
Chrome or chromium and ferrochromium			414	$100,404	1,751	$428,619
Ferrophosphorus	10	$1,055	176	13,388	6	780
Ferrosilicon	5,540	424,932	10,445	629,362	13,909	719,446
Molybdenum and ferromolybdenum	32	19,280	46	40,759		
Titanium and ferrotitanium	(a)	10	5	3,317	1	713
Tungsten and ferrotungsten		8	177	287,981	892	1,180,829
Ferrovanadium			5	24,923	4	14,331
Ferromanganese	27,168	4,258,745	33,022	4,283,541	59,254	7,775,278
Spiegeleisen	1,969	228,012	27	1,018	5,234	277,900
	34,719	4,932,042	44,317	5,384,693	81,051	10,397,896

a Ten pounds.

EXPORTS.

Ferromanganese, ferrosilicon, tungsten and ferrotungsten, and ferrovanadium exported from the United States, 1918–1920.

Variety of alloy.	1918		1919		1920	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
Ferromanganese	3,577	$806,087	2,999	$445,840	3,454	$642,570
Ferrosilicon	4,107	443,456	1,544	145,310	632	41,057
Tungsten and ferrotungsten	550	2,545,087	17	113,276	2	5,913
Ferrovanadium	675	1,774,062	29	95,560	173	705,385

PRICES.

Prices per ton of ferromanganese and spiegeleisen in the United States, 1917–1920, by months.[a]

Month.	Ferromanganese.[b]				Spiegeleisen.[c]			
	1917	1918	1919	1920	1917	1918	1919	1920
January	$175.00	$250.00	[b] $212.50	[d] $146.00	$57.50	$59.00	[c] $67.50	$46.60
February	192.50	250.00	165.00	[d] 160.00	66.25	59.00	[c] 52.50	57.60
March	212.50	250.00	134.00	[d] 172.00	77.50	65.50	[c] 42.50	60.40
April	250.00	250.00	113.75	[d] 200.00	76.75	[c] 70.00	[c] 34.50	66.85
May	375.00	[b] 250.00	110.00	[d] 200.00	78.00	[c] 71.00	[c] 31.35	75.00
June	400.00	[b] 250.00	111.75	[d] 198.00	83.00	[c] 75.00	[c] 27.50	75.00
July	400.00	[b] 250.00	111.00	[d] 190.00	85.00	[c] 75.00	34.00	75.00
August	387.50	[b] 250.00	110.00	[d] 193.75	81.25	[c] 75.00	34.00	79.35
September	380.00	[b] 250.00	105.00	167.00	80.50	[c] 75.00	34.00	82.00
October	300.00	[b] 250.00	110.00	151.00	73.50	[c] 75.00	34.00	80.00
November	247.50	[b] 250.00	110.00	[d] 153.00	63.25	[c] 75.00	34.00	74.35
December	247.50	[b] 236.00	121.00	145.00	60.00	[c] 72.50	39.00	64.40

[a] Iron Trade Review.
[b] Prices from May, 1918, to January, 1919, inclusive, based on 70 per cent ferromanganese. All other prices based on 80 per cent metal.
[c] Prices from April, 1918, to June, 1919, inclusive, based on 16 per cent spiegeleisen. All other prices based on 20 per cent metal.
[d] Prices delivered; other ferromanganese prices at seaboard.

FLUORSPAR.

SUPPLY.

Supplies of fluorspar in the United States, 1913 and 1915–1920.

Year.	Sales of domestic spar.		Imports for consumption.		Apparent consumption.[a]	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	115,580	$736,286	22,682	$71,463	138,262	$807,749
1915	136,941	764,475	7,167	22,878	144,108	787,353
1916	155,735	922,654	12,323	54,000	168,058	976,654
1917	218,828	2,287,722	13,616	114,598	232,444	2,402,320
1918	263,817	5,465,481	12,572	169,364	276,389	5,634,845
1919	138,290	3,525,574	6,943	107,631	145,233	3,633,205
1920	186,778	4,718,547	24,612	265,630	[a] 211,390	4,984,177

[a] No exports have been reported by Bureau of Foreign and Domestic Commerce. Producers reported 2,764 tons exported in 1920.

PRODUCTION.

Fluorspar shipped from mines in the United States, 1919 and 1920, by States.

State.	1919			1920		
	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.
Colorado	9,687	$150,739	$15.56	12,852	$251,308	$19.55
New Mexico	2,346	37,643	16.05	6,353	101,460	15.97
Illinois	92,729	2,430,361	26.21	120,299	3,096,767	25.74
Kentucky	32,386	883,171	27.27	46,091	1,246,942	27.05
Other States[a]	1,142	23,660	20.72	1,183	22,070	18.66
	138,290	3,525,574	25.49	186,778	4,718,547	25.26

[a] Arizona, Nevada, New Hampshire, and Utah.

Fluorspar produced in some principal countries, 1913–1919, in metric tons.[a]

Country.	1913	1914	1915	1916	1917	1918	1919
United States	104,853	86,289	124,230	141,282	198,519	239,333	125,454
Canada				1,165	3,855	6,679	[illegible]
Great Britain	54,522	34,357	33,653	55,607	65,912	54,357	[illegible]
Spain	351	79	370	277	250	350	280
France	7,524	(b)	(b)	(b)	(b)	(b)	4,894
Italy				800	800	876	900
Norway			180	140		155	(b)
Australia:							
New South Wales			424	1,407	1,631	2,315	2,046
Queensland					72		

[a] No statistics are available for Germany and Austria-Hungary, but the annual pre-war output of these countries was about 8,000 tons and 20,000 tons, respectively.
[b] Figures not yet available.

FULLER'S EARTH.

PRODUCTION.

Domestic fuller's earth marketed in the United States, 1911–1920.

Year.	Number of operators.	Quantity (short tons).	Value.	Average price per ton.	Year.	Number of operators.	Quantity (short tons).	Value.	Average price per ton.
1911	13	40,697	$383,124	$9.41	1916	10	67,822	$706,951	$10.42
1912	13	32,715	305,522	9.34	1917	11	72,567	772,087	10.64
1913	10	38,594	369,750	9.58	1918	14	84,468	1,146,354	[illegible]
1914	14	40,981	403,646	9.85	1919	10	106,145	1,998,829	18.83
1915	12	47,901	489,219	10.21	1920	12	128,487	2,506,189	19.51

IMPORTS.

Fuller's earth imported and entered for consumption in the United States, 1911–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.	Year.	Quantity (short tons).	Value.	Average price per ton.
1911	18,224	$143,594	$7.88	1916	16,801	$139,664	$8.31
1912	19,109	145,337	7.61	1917	16,994	176,417	10.38
1913	18,628	146,001	7.84	1918	12,607	165,535	[illegible]
1914	24,977	195,083	7.81	1919	13,873	189,711	13.67
1915	19,441	152,493	7.84	1920	19,235	221,893	11.54

EXPORTS.

Exports of fuller's earth are not reported separately.

GARNET (ABRASIVE).

[See under Abrasive materials.]

GAS (NATURAL).

PRODUCTION AND CONSUMPTION.

Natural gas produced and consumed in the United States, 1911–1920.

Year.	Quantity (M cubic feet).	Value.	Year.	Quantity (M cubic feet).	Value.
1911	512,993,021	$74,621,534	1916	753,170,253	$120,227,468
1912	562,203,452	84,563,957	1917	795,110,376	142,089,334
1913	581,898,239	87,846,677	1918	721,000,959	153,553,560
1914	591,866,733	94,115,524	1919	739,915,781	132,888,300
1915	628,578,842	101,312,381	1920[a]	754,336,720	136,512,500

[a] Figures preliminary and subject to revision.

GASOLINE FROM NATURAL GAS.

PRODUCTION.

Natural-gas gasoline produced in the United States, 1913 and 1915–1920.

Year.	Number of operators.	Plants.		Gasoline produced.			Gas used.		
		Number.	Daily capacity (gallons).	Quantity (gallons).	Value.	Average price per gallon (cents)	Estimated volume (M cu. ft.).	Value.	Average yield of gasoline per thousand cubic feet (gallons)
1913	232	341	152,415	24,060,817	$2,458,443	10.22	9,889,442	$566,200	2.52
1915	287	414	232,336	65,364,665	5,150,823	7.88	24,064,391	1,202,600	2.72
1916	460	596	495,448	103,492,689	14,331,148	13.85	208,705,023	[a] 14,609,300	.50
1917	750	886	902,385	217,884,104	40,188,956	18.45	429,287,797	[a] 34,343,000	.51
1918	[b] 503	1,004	[a] 1,022,072	282,535,550	50,363,535	17.8	449,108,661	[a] 40,419,700	.63
1919	[b] 611	1,191	(c)	351,535,026	64,196,763	18.3	480,403,963	[a] 41,314,700	.73
1920	[b] 576	1,154	(c)	384,743,922	71,788,122	18.7	496,430,952	[a] 41,700,000	.78

[a] Estimated.
[b] Figures for number of operators in 1918–1920 are not comparable with those for earlier years, as the method of listing has been changed.
[c] Figures not available.

GEMS AND PRECIOUS STONES.

PRODUCTION.

Value of precious stones produced in the United States, 1913 and 1915–1920.

Variety.	1913	1915	1916	1917	1918	1919	1920
Beryl	$1,615	$1,675	$2,031	$2,178	$1,906	(a)	$3,440
Copper ore gems	2,350	1,120	1,713	2,857	2,299	(a)	(a)
Corundum (sapphire)	238,835	88,214	99,180	54,204	42,414	$40,304	214,705
Diamond	6,315	608	2,680	4,175	1,910	(a)	(a)
Feldspar	1,285	368	305	(a)	(a)	(a)	520
Garnet	4,285	4,523	1,542	624	1,277	1,630	331
Hematite	.....	126	(a)	(a)	138	(a)	45
Opal	15,130	1,850	1,838	805	6,304	(a)	(a)
Peridot	375	(a)	455	(a)	1,018	.....	.....
Pyrite	50	1,042	2,075	(a)	(a)	.....	(a)
Quartz	16,861	35,724	25,707	28,273	15,211	17,632	14,676
Rhodonite	165	85	(a)	512	515	160	(a)
Smithsonite	50	(a)	.....	(a)	.....	.....	.....
Spodumene	6,520	(a)	(a)	(a)	281	(a)	.....
Thomsonite	.....	(a)	47	(a)	(a)	(a)	10
Topaz	736	862	1,005	230	907	210	767
Tourmaline	7,630	10,969	50,807	12,452	6,206	17,700	4,869
Turquoise	8,075	11,691	21,811	14,171	20,667	22,750	16,865
Variscite	6,105	3,867	3,140	2,350	753	925	(a)
Vesuvianite	152	1,535	(a)	2,765	320	.....	.....
Miscellaneous	2,920	6,172	3,457	5,416	4,397	10,452	8,977
	319,454	170,431	217,793	131,012	106,523	111,763	265,205

[a] Included under "Miscellaneous."

IMPORTS.

Value of diamonds and other precious stones imported and entered for consumption in the United States, 1913 and 1915–1920.

Year.	Diamonds.				Other stones not set.	Total, excluding pearls.	Pearls.
	Glazier's.	Dust and bort.	Rough or uncut.	Cut but not set.			
1913	$471,712	$100,704	$12,268,543	$24,812,604	$2,805,963	$40,459,526	$5,002,624
1915	366,793	75,944	7,020,646	13,177,919	1,078,391	21,719,693	4,513,909
1916	836,018	67,290	11,441,328	24,282,140	2,303,351	38,930,127	11,336,971
1917	1,098,102	349,746	13,092,855	18,421,838	1,883,810	34,846,351	4,947,509
1918	718,397	475,870	12,636,024	7,734,150	1,102,398	22,666,839	765,929
1919	984,381	1,420,442	20,306,758	64,085,610	5,161,639	91,958,830	11,008,973
1920	1,527,753	3,387,488	10,526,125	45,240,013	5,419,363	66,100,742	7,879,384

EXPORTS.

No domestic exports are recorded.

Value of foreign precious stones reexported from the United States, 1913 and 1915–1920.

Year.	Diamonds.			Other precious stones.		Total, excluding pearls.	Pearls and parts of, not strung or set.
	Uncut.	Cut but not set.	Bort.	Uncut.	Cut but not set.		
1913	$1,870	$57,117	(a)	$1,707	$7,239	$67,933	$24,787
1915	97,764	5,119	$2,470	661	10,554	116,568	116,809
1916	6,979	9,342	4	9,023	48,352	73,700	894,115
1917	7,757	400	14,962	1,512	16,842	41,473	20,353
1918			56	100	57	213	42,908
1919	3,238	25,000	(b)	b 15,653	1,783	45,674	5,386
1920			(b)	b 4,604	13,338	17,942	8,000

a No figures available. b Bort included under "Other precious stones—uncut."

GOLD AND SILVER.

PRODUCTION.

Gold and silver produced in the United States, 1913 and 1915–1920.

Year.	Gold.		Silver.	
	Quantity (troy ounces).	Value.	Quantity (troy ounces).	Commercial value.
1913	4,299,783	$88,884,400	66,801,500	$40,348,100
1915	4,887,602	101,035,700	74,961,075	37,397,300
1916	4,479,056	92,590,300	74,414,802	48,953,000
1917	4,051,440	83,750,700	71,740,362	59,078,100
1918	3,320,784	68,646,700	67,810,139	66,485,129
1919	2,918,628	60,333,400	56,682,445	63,533,652
1920	2,476,166	51,186,900	55,361,573	60,801,955

According to tables published by the Director of the Mint the total production of gold and silver in the United States is as follows:

Gold and silver produced in the United States, 1792–1920.

[The estimate for 1792-1872 is by R. W. Raymond, commissioner, and for the period since 1872 by the Director of the Mint.]

Period.	Gold.		Silver.	
	Quantity (troy ounces).	Value.	Quantity (troy ounces).	Commercial value.
1792–1847	1,186,977	$24,537,000	309,500	$404,500
1848–1872	58,279,781	1,204,750,000	118,568,200	157,749,900
1873–1920	138,526,065	2,863,587,900	2,440,513,896	1,927,680,036
	197,992,823	4,092,874,900	2,559,391,596	2,085,834,436

Gold produced in the United States, 1919 and 1920, by States.[a]

State.	1919		1920	
	Quantity (troy ounces).	Value.	Quantity (troy ounces).	Value.
Alabama			10	$200
Alaska	481,984	$9,963,500	412,915	8,535,700
Arizona	222,965	4,609,100	240,032	4,961,900
California	841,638	17,398,200	716,477	14,810,900
Colorado	495,810	10,249,300	363,218	7,508,400
Georgia	34	700	34	700
Idaho	34,085	704,600	22,668	468,600
Maine	10	200		
Massachusetts			10	200
Missouri	14	300	14	300
Montana	116,918	2,416,900	91,802	1,897,700
Nevada	225,384	4,659,100	175,451	3,626,900
New Mexico	28,319	585,400	21,720	449,000
North Carolina	5	100	54	1,100
Oregon	53,029	1,096,200	49,714	1,027,700
Philippine Islands	41,119	850,000	61,756	1,276,600
South Carolina	5	100	14	300
South Dakota	255,889	5,289,700	209,842	4,337,800
Tennessee	271	5,600	285	5,900
Texas	19	400	5	100
Utah	109,661	2,266,900	102,975	2,128,700
Vermont	19	400		
Washington	11,436	236,400	7,160	148,000
Wyoming	14	300	10	200
	2,918,628	60,333,400	2,476,166	51,186,900

[a] Figures of production issued jointly by the Bureau of the Mint and the Geological Survey. Value fixed by law at $20.67+ a troy ounce.

Silver produced in the United States, 1919 and 1920, by States.[a]

State.	1919		1920	
	Quantity (troy ounces).	Value.[b]	Quantity (troy ounces).	Value.[c]
Alabama			5	$5
Alaska	690,151	$773,570	822,410	903,228
Arizona	5,702,911	6,392,222	5,431,637	5,965,404
California	1,153,614	1,293,051	1,654,653	1,817,256
Colorado	5,966,606	6,687,790	5,166,873	5,674,622
Georgia	8	9	4	4
Idaho	5,933,076	6,650,207	7,364,785	8,088,523
Illinois	6,000	6,725	8,625	9,473
Maine	4,142	4,643		
Massachusetts			1,160	1,274
Michigan	425,610	477,054	511,664	561,945
Missouri	75,991	85,176	123,094	135,190
Montana	15,012,258	16,826,790	13,263,356	14,566,746
Nevada	7,045,395	7,896,972	7,481,866	8,217,109
New Mexico	851,821	954,781	699,745	768,509
North Carolina	19	21	10	11
Oregon	236,620	265,220	101,658	111,648
Pennsylvania			90	99
Philippine Islands	15,715	17,614	22,118	24,292
South Carolina	2	2	1	1
South Dakota	122,068	136,822	87,623	96,234
Tennessee	97,554	109,345	107,250	117,790
Texas	539,483	604,690	522,818	574,195
Utah	12,542,623	14,058,650	11,755,411	12,910,615
Vermont	2,200	2,466		
Virginia	8	9		
Washington	258,270	289,487	177,758	195,226
Wyoming	300	336	56,959	62,556
	56,682,445	63,533,652	55,361,573	60,801,955

[a] Figures of production issued jointly by the Bureau of the Mint and the Geological Survey.
[b] Valued at $1.12087 an ounce, the commercial (dealers') buying price of silver.
[c] Valued at $1.09827 an ounce, the average of the New York prices, to the end of May when the Pittman Act became effective; thereafter at $1 an ounce, as provided by that act.

World's production of gold, 1913 and 1915–1919, by countries.

[Figures supplied by U. S. Bureau of the Mint.]

Country.	1913	1915	1916	1917	1918	1919
North America:						
United States	$88,884,400	$101,035,700	$92,590,300	$83,750,700	$68,646,700	$60,333,400
Canada	16,598,900	18,977,901	19,235,000	15,273,000	14,687,900	15,850,400
Mexico	19,308,800	6,559,275	7,690,700	9,000,000	16,824,700	15,676,500
Central America	2,721,700	2,970,271	3,517,600	3,122,000	3,400,000	3,300,000
Africa	207,326,500	217,851,898	222,948,900	214,304,300	197,073,600	193,896,500
Australasia	53,113,200	48,988,177	40,475,800	34,398,100	29,268,600	26,911,500
Europe:						
Russia, Finland, and Siberia	26,508,700	26,322,746	22,500,000	18,000,000	12,000,000	11,000,000
Austria-Hungary	2,179,300	1,392,465	1,000,000	150,000	180,000	
Germany	135,600					
Sweden	17,600	25,323	12,200	10,000	10,000	10,000
Italy	17,200	2,295	2,000	700	22,800	15,300
Spain and Portugal	2,300	661				
Turkey	500	475				
France	2,127,400	1,400,000	1,000,000	700,000	500,000	151,000
Great Britain	17,900	19,266	5,700	5,000		
Serbia	328,000					
Greece						4,600
Czechoslovakia						125,600
South America:						
Argentina	2,600		15,300	4,600	4,000	4,000
Bolivia and Chile	336,884	814,418	301,000	770,700	770,000	770,000
Colombia	2,971,700	5,453,148	6,173,900	5,000,000	4,866,500	6,000,000
Ecuador	406,500	545,674	560,000	887,800	800,000	800,000
Brazil	2,254,700	2,424,515	2,890,000	2,958,000	2,800,000	2,000,000
Venezuela	419,040	1,395,349	1,269,900	636,900	473,200	600,000

World's production of gold, 1913 and 1915–1919, by countries—Continued.

Country.	1913	1915	1916	1917	1918	1919
South America—Continued.						
Guiana:						
British	$1,353,500	$923,892	$660,700	$519,000	$400,000	$335,200
Dutch	470,400	449,054	438,200	445,000	322,200	329,300
French	3,050,600	1,959,793	1,600,000	1,438,500	1,100,000	1,100,000
Peru	912,280	1,109,891	1,267,400	1,254,100	1,250,000	1,348,400
Uruguay	29,900	11,836	12,000	10,000	10,000	10,000
Asia:						
Japan	3,614,400	5,386,066	5,185,600	4,679,700	5,105,900	4,824,900
China	3,658,900	2,804,692	3,100,700	3,600,100	3,600,000	3,300,000
Indo-China	74,700	43,659	65,600	50,000	50,000	40,000
Chosen (Korea)	3,582,500	3,739,477	4,122,400	3,363,800	3,300,000	2,800,000
Siam	56,500	.....	.....	.....	.....	.....
India, British	12,178,000	11,522,457	11,206,500	10,812,800	10,028,000	10,486,000
East Indies, British	1,352,000	3,100,000	3,000,000	2,853,700	2,571,400	2,564,000
East Indies, Dutch	3,387,100					
Federated Malay States	282,400	351,527	327,900	342,400	345,300	339,000
Formosa	814,600	1,143,017	1,001,200	1,081,200	513,700	417,200
Sarawak	.....	.....	.....	.....	.....	446,000
	460,497,204	468,724,918	454,176,500	419,422,100	380,924,500	365,788,800

World's production of silver, 1913 and 1915–1919, by countries, in troy ounces.

[Figures supplied by U. S. Bureau of the Mint.]

Country.	1913	1915	1916	1917	1918	1919
North America:						
United States	66,801,500	74,961,075	74,414,800	71,740,400	67,810,100	56,682,400
Canada	31,524,708	26,625,960	25,459,700	22,221,300	21,284,600	16,020,700
Mexico	70,703,828	39,570,151	22,838,400	35,000,000	62,517,000	65,904,200
Central America	2,135,641	2,920,496	2,602,500	2,369,500	2,900,000	2,800,000
South America:						
Bolivia and Chile	3,932,594	3,870,065	4,402,100	4,151,600	4,335,000	4,335,000
Argentina	35,271	.....	21,300	29,000	25,000	25,000
Brazil	28,364	21,523	22,000	25,000	25,000	25,000
Columbia	587,683	351,271	309,400	325,000	325,000	494,300
Ecuador	22,642	24,655	30,000	45,000	40,000	40,000
Peru	9,971,067	9,419,950	10,787,000	10,864,400	10,800,000	9,821,700
Guiana and Uruguay	51,111	.....	8,500	8,000	8,000	8,000
Venezuela	.....	.....	.....	3,300	3,000	4,100
Europe:						
Austria-Hungary	2,104,107	1,772,699	1,500,000	1,500,000	1,750,000	596,400
Czechoslovakia	.....	.....	.....	.....	.....	
Germany	4,984,677	.....	.....	.....	.....	.....
France	520,766	.....	.....	.....	.....	12,000
Great Britain	128,543	96,450	86,500	75,000	50,000	68,400
Greece	803,750	591,464	350,000	350,000	350,000	160,000
Italy	423,888	493,856	486,500	486,500	500,000	350,000
Norway	247,988	413,867	439,100	294,900	270,200	312,800
Spain and Portugal	4,437,637	4,567,454	4,517,800	2,850,000	3,100,000	1,548,200
Russia	.....	638,403	550,000	500,000	400,000	400,000
Serbia	28,758	.....	10,000	20,000	20,000	20,000
Sweden	58,969	24,230	37,900	35,000	31,500	31,500
Turkey	1,509,133	1,509,133	500,000	400,000	400,000	100,000
Australasia	18,128,577	9,250,000	10,700,000	10,000,000	10,000,000	7,188,000
Asia:						
British India	.....	284,875	280,000	275,000	270,000	190,600
China	.....	18,230	30,000	63,900	70,000	65,000
Chosen (Korea)	15,048	21,897	25,000	26,500	26,000	20,000
Dutch East Indies	465,980	400,000	400,000	400,000	400,000	1,006,800
Indo-China	.....	1,056	1,000	1,000	1,000	1,000
Formosa	51,763	47,653	47,700	39,600	26,900	25,000
Japan	4,649,910	5,120,293	5,805,700	7,111,700	6,600,400	4,950,500
Burma	.....	.....	977,100	1,793,700	1,970,500	1,975,000
Sarawak	.....	.....	.....	.....	.....	6,300
Africa:						
Algeria	.....	.....	.....	.....	.....	170,800
Belgian Kongo	1,454	4,770	11,000	10,300	10,500	10,000
Egypt	.....	1,657	1,200	900	800	300
French East Africa	.....	.....	.....	.....	.....	.....
Madagascar	.....	.....	20,000	20,000	20,000	17,700
Rhodesia	121,537	185,233	200,700	212,000	175,700	180,600
Transvaal, Cape Colony, Natal	933,191	996,379	968,900	938,100	877,500	891,300
Portuguese East Africa	.....	.....	1,200	1,200	1,200	1,000
	225,410,085	184,204,745	168,843,000	174,187,800	197,394,900	176,459,600

IMPORTS AND EXPORTS.

Value of gold and silver imported into and exported from the United States, 1919 and 1920.

1919.

	Imports.	Exports.	Excess of—	
			Imports.	Exports.
GOLD.				
Contained in domestic ore and base bullion		$20,719		$20,719
Contained in foreign ore and base bullion	$16,744,430		$16,744,430	
Domestic bullion refined		122,055,164		122,055,164
Foreign bullion refined	33,183,373		33,183,373	
United States coin	11,244,897	245,496,208		234,251,311
Foreign coin	15,361,346	613,157	14,748,189	
	76,534,046	368,185,248	64,675,992	356,327,194
Excess exports over imports				291,651,202
SILVER.				
Contained in domestic ore and base bullion		6,693		6,693
Contained in foreign ore and base bullion	74,073,332	1,252	74,072,080	
Domestic bullion refined		186,533,723		186,533,723
Foreign bullion refined	8,382,030	23,644,997		15,262,967
United States coin	1,057,135	21,224,827		20,167,692
Foreign coin	5,897,521	7,609,559		1,712,038
	89,410,018	239,021,051	74,072,080	223,683,113
Excess exports over imports				149,611,033

1920.

GOLD.				
Contained in domestic ore and base bullion		$11,260		$11,260
Contained in foreign ore and base bullion	$16,984,171		$16,984,171	
Domestic bullion refined	3,845,775	37,203,349		33,357,574
Foreign bullion refined	322,415,060	1,901,594	320,513,466	
United States coin	18,093,178	282,293,126		264,199,948
Foreign coin	55,730,089	681,879	55,048,210	
	417,068,273	322,091,208	392,545,847	297,568,782
Excess imports over exports			94,977,065	
SILVER.				
Contained in domestic ore and base bullion		16,522		16,522
Contained in foreign ore and base bullion	69,845,999	900	69,845,099	
Domestic bullion refined	3,053	4,349,365		4,346,312
Foreign bullion refined	7,871,083	89,961,684		82,090,601
United States coin	2,093,073	14,771,492		12,678,419
Foreign coin	8,246,833	4,516,261	3,730,572	
	88,060,041	113,616,224	73,575,671	99,131,854
Excess exports over imports				25,556,183

PRICES.

Gold is valued by law at $20.67+ a troy ounce.
For prices of silver, see statement on page 16a.

GRAPHITE.

PRODUCTION.

Crystalline graphite sold in the United States, 1918–1920, by States.

State.	1918		1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
Alabama	7,795,475	$999,152	3,569,030	$272,413	4,894,648	$306,977
New York	3,266,518	273,188	(a)	(a)		
Pennsylvania	1,016,900	112,059	484,060	26,008	4,737,712	269,467
Other States [b]	782,946	70,400	4,033,101	432,725		
	12,861,839	1,454,799	8,086,191	731,141	9,632,360	576,444

[a] Included under "Other States."
[b] 1918: California, Montana, and Texas: 1919: California, New York, and Texas: 1920: California, Montana, and Texas.

Domestic natural graphite sold in the United States, 1913 and 1915–1920.

Year.	Amorphous.		Crystalline.		Total.	
	Quantity (short tons).	Value.	Quantity (pounds).	Value.	Quantity (short tons).	Value.
1913	2,243	$39,428	5,064,727	$254,328	4,775	$293,756
1915	1,181	12,358	7,074,370	417,273	4,718	429,631
1916	2,622	20,723	10,931,989	914,748	8,088	935,471
1917	8,301	73,481	10,584,080	1,094,398	13,593	1,167,879
1918	6,560	69,455	12,861,839	1,454,799	12,991	1,524,254
1919	3,379	47,716	8,086,191	731,141	7,422	778,857
1920	4,694	49,758	9,632,360	576,444	9,510	626,202

World's production of natural graphite, 1913–1919, in metric tons.

Country.	1913	1914	1915	1916	1917	1918	1919
United States: [a]							
Amorphous	2,035	1,565	1,071	2,378	7,530	5,951	3,065
Crystalline	2,297	2,368	3,209	4,959	4,801	5,834	3,668
Canada [a]	1,961	1,495	2,391	3,588	3,369	2,826	1,199
Mexico [b]	4,023	3,865	1,525	4,836	6,869	5,080	4,995
Brazil [b]	2½	.....	2	1	15	45	2
Austria and Styria	17,282	11,062	14,815	[c] 21,000	[c] 18,000	17,415	[c] 17,000
Bohemia and Moravia	32,175	26,973	20,231	26,313	29,073	27,355	31,234
France	1,194	500	.....	.....	1,650	2,132	375
Germany	12,057	13,619	17,292	30,574	42,825	64,080	(d)
Italy	11,145	8,567	6,176	8,182	12,117	11,653	7,626
Spain	.....	.....	30	1,240	1,980	710	1,958
Sweden	88	56	87	194	4	102	.....
Ceylon [b]	28,996	14,463	22,173	33,956	27,572	15,701	6,504
French Indo-China [b]	.....	.....	.....	.....	8,000	15,000	(d)
British India	.....	.....	71	1,525	105	82	129
Japan	667	573	666	1,149	1,331	1,886	(d)
Chosen (Korea) [b]	14,543	9,149	7,044	16,963	16,183	13,659	[c] 12,000
Madagascar	7,997	11,232	15,940	26,524	35,000	16,000	2,000
Union of South Africa	35	31	37	55	78	72	78
Australia	.....	7	71	72	89	208	102
	136,497½	105,325	112,831	183,509	216,591	205,791	.....

[a] Shipments and sales [b] Exports. [c] Estimated. [d] Figures not yet available.

IMPORTS.

Graphite imported for consumption in the United States, 1913–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1913	28,879	$2,109,791	1917	42,577	$8,961,988
1914	21,990	1,398,209	1918	19,498	3,092,475
1915	23,075	2,241,163	1919	26,626	2,978,096
1916	42,930	7,279,883	1920	21,095	1,711,312

EXPORTS.

Graphite exported from the United States, 1913 and 1915–1920.

Year	Unmanufactured graphite.		Manufactures of graphite.
	Quantity (pounds).	Value.	
1913	5,383,981	$391,906	$238,302
1915	1,057,764	52,583	536,572
1916	1,595,608	98,118	1,339,259
1917	5,146,816	349,563	891,687
1918	1,907,719	121,555	731,518
1919	1,258,040	90,185	788,755
1920	1,213,616	112,771	610,261

PRICES.

Prices of best grades of domestic flake graphite (sales at mines) and Ceylon lump (New York prices), in cents per pound, 1911–1920.

Year.	Domestic flake.	Ceylon lump.	Year.	Domestic flake.	Ceylon lump.
1911	6 – 7	8½– 9	1916	10–16	20 –28
1912	6 – 7	8½–10	1917	12–18	28 –32
1913	6 – 8	9½–11	1918	10–17½	15½–28½
1914	6½– 8	6½– 9½	1919	4–10½	14 –15½
1915	7 –10	9⅝–20	1920	6– 9	9 –14

GRINDSTONES AND PULPSTONES.

[See under Abrasive materials.]

GYPSUM.

PRODUCTION.

Gypsum produced in the United States, 1911–1920.

Year.	Crude mined (short tons).	Crude and calcined sold (total value).	Year.	Crude mined (short tons).	Crude and calcined sold (total value).
1911	2,323,970	$6,462,035	1916	2,757,730	$7,959,032
1912	2,500,757	6,563,908	1917	2,696,226	11,116,452
1913	2,599,508	6,774,822	1918	2,057,015	11,470,854
1914	2,476,465	6,895,989	1919	2,420,103	15,727,907
1915	2,447,611	6,596,893	1920	3,129,142	24,533,065

IMPORTS.

Gypsum imported into the United States comes almost wholly from Nova Scotia and New Brunswick and enters the ports of New England and other North Atlantic States.

Gypsum imported and entered for consumption in the United States, 1913 and 1915–1920.

Year.	Unground.		Ground or calcined.		Value of manufactured plaster of Paris.	Keenes cement.		Total value.
	Quantity (short tons).	Value.	Quantity (short tons).	Value.		Quantity (short tons).	Value.	
1913	447,383	$473,594	4,542	$31,277	$52,051	1,851	$26,185	$583,107
1915	336,856	356,791	5,749	22,873	10,095	427	6,656	396,415
1916	254,131	275,043	11,706	72,345	9,085	600	9,890	366,363
1917	240,269	265,504	16,533	109,732	6,016	484	8,003	389,255
1918	50,653	55,004	6,117	70,028	1,765	111	2,259	129,056
1919	171,733	211,946	10,415	126,405	7,719	187	5,984	352,054
1920	282,486	397,942	15,921	179,191	10,282	202	5,338	592,753

EXPORTS.

Figures are not available for exports of gypsum.

ILMENITE.

[See under Titanium minerals.]

IRON ORE, PIG IRON, AND STEEL.

IRON ORE.

[Exclusive of all domestic ore containing 5 per cent or more of manganese. For data regarding such ore, see under Manganese.]

PRODUCTION.

Iron ore mined in the United States, by mining districts and varieties, 1919–1920, in long tons.

District.	1919 (total).	1920				
		Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
Lake Superior [a]	52,392,339	57,860,530	.....	.....	.....	57,860,530
Birmingham	4,531,032	4,953,653	266,561	.....	.....	5,220,214
Chattanooga	546,938	393,733	187,184	.....	.....	580,917
Adirondack	740,315	.....	.....	783,590	.....	783,590
Northern New Jersey and southeastern New York	491,458	.....	.....	546,365	.....	546,365
Other districts	2,263,336	[b] [c] 675,607	[c] 871,916	[b] 1,061,586	3,740	2,612,849
	60,965,418	[b] [c] 63,883,523	[c] 1,325,661	[b] 2,391,541	3,740	67,604,465

[a] Includes only those mines in Wisconsin which are in the true Lake Superior district.
[b] Some magnetite included with hematite.
[c] Some hematite included with brown ore.

Iron ore mined in the United States, by varieties, 1913 and 1915–1920, in long tons.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
1913	57,933,251	1,682,063	2,357,274	7,849	61,980,437
1915	52,227,324	1,488,709	1,807,002	3,455	55,526,490
1916	70,728,024	1,904,484	2,533,364	1,800	75,167,672
1917	70,743,513	1,992,332	2,553,006	.....	75,288,851
1918	65,894,709	1,613,844	2,149,725	.....	69,658,278
1919	57,719,582	1,127,397	2,118,439	.....	60,965,418
1920	63,883,523	1,325,661	2,391,541	3,740	67,604,465

Iron ore mined in the Lake Superior district, by ranges, 1913 and 1915–1920, in long tons.

Year.	Marquette.	Menominee	Gogebic.	Vermilion.	Mesabi.	Cuyuna.	Total.
1913	3,977,808	4,997,246	4,743,515	1,536,115	36,378,671	744,007	52,377,362
1915	3,817,892	4,665,465	4,996,237	1,541,645	30,802,409	1,120,606	46,944,254
1916	4,792,987	6,649,578	7,707,101	1,704,440	41,325,341	1,555,641	63,735,088
1917	4,638,374	6,366,483	7,881,232	1,481,301	41,127,323	1,986,608	63,481,321
1918	3,946,554	6,041,637	7,837,634	1,192,677	39,055,977	1,705,315	59,779,794
1919	4,158,751	4,863,968	7,368,994	1,051,795	33,262,954	1,685,877	52,392,339
1920	4,457,609	5,651,542	8,298,206	1,053,518	36,641,880	1,757,775	57,860,530

Iron ore shipped from mines in the United States, 1919 and 1920, by States.

State.	1919		1920	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.
Alabama	4,895,309	$11,954,425	5,833,317	$15,993,985
California	2,053	13,796	6,592	44,844
Georgia	74,007	294,619	104,482	460,633
Michigan	12,911,727	49,774,212	18,862,578	85,749,217
Minnesota	34,547,356	121,107,247	39,747,594	163,538,054
Missouri	53,626	223,144	50,825	230,827
Montana	(a)	(a)	10,803	73,889
New Jersey	336,629	1,712,255	417,100	2,595,949
New Mexico	224,553	506,538	274,705	547,370
New York	701,688	4,002,312	959,408	6,263,252
North Carolina	58,778	231,530	71,810	293,382
Pennsylvania	616,271	1,340,219	719,813	1,406,929
Tennessee	282,988	817,549	373,012	1,355,217
Utah	44,185	177,327	36,159	151,174
Virginia	304,920	1,139,349	320,109	1,227,601
Wisconsin	881,740	3,253,290	1,067,159	4,333,307
Other States b	436,954	764,705	425,875	740,697
	56,372,784	197,312,517	69,281,341	285,006,327

a Included under "Other States."
b 1919: Colorado, Connecticut, Idaho, Maryland, Massachusetts, Montana, Texas, Washington, and Wyoming; 1920: Arizona, Colorado, Connecticut, Idaho, Maryland, Massachusetts, Nevada, Washington, and Wyoming.

STOCKS.

Stocks of iron ore at mines in the United States, December 31, 1919 and 1920, in long tons.

State.	1919	1920	State.	1919	1920
Alabama	402,647	463,341	New Jersey	267,162	269,298
California	.....	70	New Mexico	486	.....
Georgia	7,042	3,885	New York	203,267	154,669
Iowa	12,165	12,165	Pennsylvania	45,500	54,400
Maryland	2,140	1,580	Tennessee	.....	3,709
Massachusetts	3,960	1,530	Virginia	44,315	42,630
Michigan	6,874,604	5,532,368	Wisconsin	431,312	341,212
Minnesota	4,801,460	4,493,158			
Missouri	1,440	4,779		13,097,500	11,378,794

IMPORTS AND EXPORTS.

Iron ore imported into and exported from the United States, 1913 and 1915–1920.

Year.	Imports.		Exports.	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1913	2,594,770	$8,336,819	1,042,151	$3,513,419
1915	1,341,281	4,181,645	707,641	2,181,629
1916	1,325,736	4,566,514	1,183,952	3,702,496
1917	971,663	3,655,392	1,132,313	4,464,111
1918	787,468	3,464,304	1,256,383	5,535,090
1919	476,461	2,385,689	996,569	4,308,746
1920	1,273,456	4,963,654	1,145,037	6,198,927

PRICES.

Average price of iron ore per long ton at the mines in the United States, 1913 and 1915–1920.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	General average.
1913	$2.21	$1.88	$2.07	$2.06	$2.19
1915	1.80	1.80	2.50	2.44	1.83
1916	2.32	2.03	3.11	3.00	2.34
1917	3.12	2.95	4.29	.....	3.15
1918	3.35	3.51	4.60	.....	3.39
1919	3.48	3.63	4.08	.....	3.50
1920	4.09	4.19	4.59	.....	4.11

Selling prices of iron ore per long ton at lower Lake ports at date of buying movement, 1913 and 1915–1920.[a]

Season.	Date of buying movement.	Season iron-ore prices.			
		Old range Bessemer.	Mesabi Bessemer.	Old range non-Bessemer.	Mesabi non-Bessemer.
1913	Nov. 19, 1912	$4.40	$4.15	$3.60	$3.40
1915	Apr. 19, 1915	3.75	3.45	3.00	2.80
1916	Dec. 7, 1915	4.45	4.20	3.70	3.55
1917	Nov. 22, 1916	5.95	5.70	5.20	5.05
1918	Apr. 1, 1918	5.95	5.70	5.20	5.05
	July 1, 1918	6.40	6.15	5.65	5.50
	Oct. 1, 1918	6.65	6.40	5.90	5.75
1919	Apr. 28, 1919	6.45	6.20	5.70	5.55
1920	Feb. 2, 1920	7.45	7.20	6.70	6.55

[a] Iron Trade Review.

PIG IRON.

PRODUCTION.

Pig iron shipped from blast furnaces in the United States, 1919 and 1920, by States.

State.	1919		1920	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.
Alabama	2,044,937	$53,092,133	2,339,939	$76,520,797
Illinois	2,532,341	61,829,286	3,238,814	90,736,015
Indiana	2,287,068	51,474,116	2,418,048	61,852,856
Kentucky	149,951	4,508,129	230,316	7,306,711
Michigan	416,277	13,418,185	464,197	16,812,062
Missouri	49,383	1,649,271	81,682	3,678,623
New Jersey	111,362	3,505,635	88,408	3,380,145
New York	1,854,594	49,784,659	2,415,627	89,416,703
Ohio	6,994,999	178,999,271	8,229,770	246,326,276
Pennsylvania	11,901,992	307,824,587	13,472,814	448,251,415
Tennessee	155,663	5,152,860	217,887	9,271,324
Virginia	288,458	9,094,135	390,372	16,086,946
West Virginia	250,310	6,267,067	489,689	15,927,822
Wisconsin	282,830	8,320,521	363,588	12,355,028
Other States [a]	810,066	20,995,188	1,269,076	42,981,373
	30,130,231	775,915,043	35,710,227	1,140,904,096

[a] 1919: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, Texas, and Washington; 1920: Colorado, Connecticut, Maryland, Massachusetts, and Minnesota.

Pig iron shipped from blast furnaces in the United States, 1911–1920.

Year.	Quantity (long tons).	Value.	Year.	Quantity (long tons).	Value.
1911	23,257,288	$327,334,624	1916	39,126,324	$663,478,118
1912	30,180,969	420,563,388	1917	38,612,546	1,053,785,975
1913	30,388,935	458,342,345	1918	38,230,440	1,180,759,565
1914	22,263,263	298,777,429	1919	30,130,231	775,915,043
1915	30,384,486	401,409,604	1920	35,710,227	1,140,904,096

IMPORTS.

Pig iron, including kentledge, ferromanganese, ferrosilicon, and spiegeleisen, imported into the United States, 1913–1920.

Year.	Quantity (long tons).	Value.	Year.	Quantity (long tons).	Value.
1913	156,450	$6,557,095	1917	76,786	$7,872,105
1914	138,903	4,694,186	1918	34,711	4,968,056
1915	89,836	4,108,180	1919	101,665	6,565,106
1916	135,349	10,239,868	1920	185,944	12,801,834

EXPORTS.

Pig iron exported from the United States, 1913–1920.

Year.	Quantity (long tons).	Value.	Year.	Quantity (long tons).	Value.
1913	277,648	$4,026,306	1917	656,220	$24,037,051
1914	114,423	1,638,102	1918	269,575	11,576,721
1915	224,509	3,667,167	1919	321,261	12,313,183
1916	607,236	15,381,431	1920	216,828	10,074,377

PRICES.

Average monthly prices per ton of principal grades of pig iron in the United States, 1919 and 1920.[a]

Month.	1919				1920			
	Foundry pig iron at Valley furnaces.	Foundry pig iron at Birmingham, Ala., furnaces.	Bessemer pig iron at Valley furnaces.	Basic pig iron at Valley furnaces.	Foundry pig iron at Valley furnaces.	Foundry pig iron at Birmingham, Ala., furnaces.	Bessemer pig iron at Valley furnaces.	Basic pig iron at Valley furnaces.
January	$31.00	$31.00	$32.20	$30.00	$38.46	$37.77	$37.65	$36.62
February	31.00	31.00	32.20	30.00	41.00	40.00	41.67	42.13
March	27.88	28.44	30.73	28.53	42.00	40.00	42.00	41.50
April	26.75	26 75	27.95	25.75	42.42	40.00	42.21	42.13
May	26.75	25.28	27.95	25.75	43.96	42.00	42.54	43.12
June	26.75	24.14	27.95	25.09	45.00	42.00	43.23	43.62
July	26.75	26.01	27.95	25.75	45.15	42.00	45.58	45.42
August	26.75	27.18	27.95	25.75	47.85	42.00	47.35	46.96
September	26.75	27.50	27.95	25.75	50.00	42.00	48.50	48.50
October	26.90	27.78	27.95	25.75	46.62	42.00	47.67	44.00
November	30.76	30.21	29.44	27.83	40.72	39.02	40.84	37.62
December	35.46	34.81	35.27	33.88	35.77	36.42	35.00	33.00
Average	28.63	28.34	29.62	27.49	43.25	40.43	42.85	42.05

[a] Metal Statistics, American Metal Market.

STEEL.

PRODUCTION.

Steel produced in the United States, 1913 and 1915–1920, in long tons.[a]

Year.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1913	9,545,706	21,599,931	121,226	34,011	31,300,874
1915	8,287,213	23,679,102	113,782	70,939	32,151,036
1916	11,059,039	31,415,427	129,692	169,522	42,773,680
1917	10,479,960	34,148,893	126,716	305,038	45,060,607
1918	9,376,236	34,459,391	115,112	511,693	44,462,432
1919	7,271,562	26,948,694	63,572	387,404	34,671,232
1920	8,883,087	32,671,895	72,265	505,687	42,132,934

[a] According to the American Iron and Steel Institute.

LEAD.

SUPPLY.

Apparent consumption of refined primary lead in the United States (refinery stocks disregarded), 1913 and 1915–1920, in short tons.

	1913	1915	1916	1917	1918	1919	1920
Supply:							
Stock in bonded warehouses Jan. 1.	47	2	.....	535	2,685	472	234
Imports of pigs, bars, and old	41	410	5,655	5,793	5,240	5,107	35,719
Production	462,460	550,055	571,134	610,769	640,195	482,220	529,657
	462,548	550,467	576,789	617,097	648,120	487,799	565,610
Withdrawn:							
Exports of foreign lead—							
From warehouse	44,544	38,618	9,880	37,652	59,416	40,976	17,363
In manufactures, with benefit of drawback	9,779	3,983	5,171	7,537	3,426	1,936	6,175
Exports of domestic lead	.....	88,306	100,500	53,688	41,831	10,510	2,730
Stock in bonded warehouses Dec. 31.	79	.....	535	2,685	472	234	1,322
	54,402	130,907	116,086	101,562	105,145	53,656	27,590
Apparent consumption	408,146	419,560	460,703	515,535	542,975	434,143	538,020

PRODUCTION.

REFINED PRIMARY LEAD.

Refined primary lead produced in the United States, 1913 and 1915–1920, in short tons.

	1913	1915	1916	1917	1918	1919	1920
Domestic ore:							
Desilverized lead	250,578	301,564	316,469	303,679	282,024	208,751	220,327
Soft lead	131,867	161,461	167,515	188,503	210,463	147,744	189,854
Desilverized soft lead	29,433	44,001	68,244	56,268	47,418	67,938	66,668
Total from domestic ore	411,878	507,026	552,228	548,450	539,905	424,433	476,849
Foreign ore:							
Africa	5,976	.....	328	1,738	1,519	644	1,171
Australia	.....	.....	.....	.....	282	69	450
Canada	16	1,174	1,231	1,100	7,550	1,895	1,186
Central America	.....	1	7	.....	.....	12	22
Mexico	4,512	5,437	1,917	7,607	4,798	2,261	2,729
South America	2,617	2,829	2,366	1,533	1,101	2,537	2,747
Other foreign	102	140	236	3,894	84	238	109
Foreign base bullion:							
Canada	.....	.....	1,072	6,750	8,108	567	1,919
Mexico	37,359	33,173	11,598	39,508	76,809	49,564	42,421
South America	.....	275	151	189	39	.....	54
Total from foreign ore and base bullion	50,582	43,029	18,906	62,319	100,290	57,787	52,808
Grand total from all sources	462,460	550,055	571,134	610,769	640,195	482,220	529,657
Production of antimonial lead	16,665	23,224	24,038	18,646	18,570	13,874	12,535

Refined primary lead produced in the United States from domestic ores, 1911–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	391,995	$35,279,550	1916	552,228	$76,207,000
1912	392,517	35,326,530	1917	548,450	94,333,000
1913	411,878	36,245,264	1918	539,905	76,667,000
1914	512,794	39,998,000	1919	424,433	44,990,000
1915	507,026	47,660,000	1920	476,849	76,296,000

The following statistics of the world's production of lead, though incomplete, show approximately the foreign production during the war. The figures in black-faced type are taken from the official statistics of the countries named; those in the ordinary type are taken from statistical handbooks, consular reports, market letters, and trade journals.

World's production of work lead, 1913 and 1915–1920, in metric tons.

[By countries where smelted but not necessarily refined.]

Country.	1913	1915	1916	1917	1918	1919	1920
Australia	110,444	102,721	134,072	144,950	163,368	83,408	7,802
Africa:							
Rhodesia	295	25	.....	5,028	8,311	10,172	13,247
Tunis	(a)	(a)	(a)	(a)	16,533	(a)	(a)
Austria-Hungary [b]	24,000	34,500	36,500	34,400	33,000	(a)	(a)
Belgium	103,480	16,770	15,560	22,745	20,630	53,590	16,040
Canada	17,202	19,740	19,879	20,709	17,005	16,143	13,733
France	28,817	14,539	24,276	21,235	12,778	10,928	(a)
Germany:							
Upper Silesia [c]	41,300	28,750	41,620	32,960	23,960	18,580	[d]8,579
Other Germany	147,000	93,000	65,000	53,000	46,000	33,000	(a)
Great Britain	30,990	16,020	12,980	11,614	11,269	11,458	(a)
Greece	18,309	11,595	9,424	1,422	4,093	3,841	4,815
India (Burma)	5,951	13,738	14,011	17,233	19,380	19,396	24,198
Italy	21,674	21,812	24,862	16,237	18,332	16,530	(a)
Japan	3,777	4,764	11,371	15,807	10,684	5,771	(a)
Mexico [e]	62,000	31,384	19,966	46,612	88,503	78,645	84,200
Russia	1,523	935	540	(a)	(a)	(a)	(a)
South America [e]	2,729	4,667	4,267	4,571	5,268	7,234	5,510
Spain	198,829	171,474	147,407	176,309	169,709	125,721	(a)
Sweden	1,235	1,917	2,076	3,174	2,241	827	800
Turkey [b]	13,900	1,100	1,100	3,000	3,300	1,000	1,000
United States (refined lead)	385,643	468,656	506,490	511,942	503,702	391,982	440,221
Known output	1,219,000	1,058,000	1,091,000	1,143,000	1,178,000	888,000	620,000

[a] Figures not yet available.
[b] Metallgesellschaft (statistical publication), 21st vol., 1921.
[c] Upper Silesian Mining and Smelting Syndicate.
[d] Figures cover January–June only.
[e] Amer. Bur. Metal Statistics Year Book, 1920.

SECONDARY LEAD.

Secondary lead produced in the United States, 1913 and 1915–1920, in short tons.

	1913	1915	1916	1917	1918	1919	1920
Pig lead	33,104	36,400	56,700	45,100	41,146	55,684	56,350
Lead in alloys	39,730	42,500	39,600	48,400	55,954	66,416	68,300
Total recovered lead	72,834	78,900	96,300	93,500	97,100	122,100	124,650

IMPORTS.

Lead imported into the United States in ore, base bullion, and refined, by countries, 1913 and 1915–1920, in pounds.

[General imports.]

Country.	1913	1915	1916	1917	1918	1919	1920
United Kingdom	404,594	185,236	261,406	8,689,992	56,710	89,840	27,066,873
Germany	262,132	.....	.....	.....	.....	.....	3,109,555
Other European countries	143,293	32,537	314,353	255,907	5,800	.....	8,590,076
Total from Europe	810,019	217,773	575,759	8,945,899	62,510	89,840	38,766,504
Canada	338,569	2,303,170	12,606,216	11,738,379	28,225,878	10,391,115	8,199,234
Mexico	95,693,439	94,247,384	48,395,670	125,782,759	162,259,199	125,541,614	131,815,278
South America	8,766,327	5,420,567	6,235,758	4,556,460	1,962,124	5,504,416	7,085,351
Other countries	8,685,612	802,516	2,845,949	5,520,323	4,705,049	286,142	11,163,160
Total imports	114,293,966	102,991,410	70,659,352	156,543,820	197,214,760	141,813,127	197,029,527

Lead imported into the United States, by classes, 1913 and 1915–1920, in pounds.

[General imports.]

Year.	Lead in ore (lead content).	Base bullion.		Pigs, bars, sheets, and old.	Total lead content.
		Gross weight.	Lead content.		
1913	19,883,313	96,908,170	94,327,654	82,999	114,293,966
1915	18,185,140	86,247,995	83,986,988	819,282	102,991,410
1916	35,086,100	24,943,660	24,262,435	11,310,817	70,659,352
1917	41,292,876	109,279,997	103,664,970	11,585,974	156,543,820
1918	37,070,340	155,810,003	149,663,889	10,480,531	197,214,760
1919	19,573,856	115,317,160	112,024,518	10,214,753	141,813,127
1920	29,488,816	101,476,550	96,103,603	71,437,108	197,029,527

Lead imported and entered for consumption in the United States, 1913 and 1915–1920, by classes.

Year.	Lead in ore.		Base bullion.		Pigs, bars, and old.		Sheets, pipe, and shot.		Not otherwise specified (value).	Total value.
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.		
1913	2,306,972	$75,835	17,665,227	$388,116	4,621,270	$105,738	39,171	$3,291	$12,710	$585,690
1915	2,865,792	96,010	15,496,230	519,355	997,368	32,951	201,510	17,059	107,580	772,955
1916	10,125,983	368,824	5,242,171	208,277	6,388,097	331,235	532	63	106,560	1,014,959
1917	5,438,931	207,370	6,965,849	470,539	1,756,223	85,743	12,538	2,699	10,287	776,638
1918	6,064,902	344,080	3,559,071	180,070	1,139,950	56,694	6,892	624	36,723	618,191
1919	4,106,823	196,363	31,796,693	1,130,937	10,174,115	415,094	8,018	628	17,187	1,760,209
1920	13,700,499	908,619	66,816,820	3,340,600	68,901,959	3,887,821	81,396	5,483	21,328	8,163,851

EXPORTS.

Lead exported from the United States, 1915–1920, by classes.

Year.	Pigs and bars.				Foreign lead used in articles exported with benefit of drawback.[a]		Manufactures of lead from both domestic and foreign ores.
	From domestic ore.		From foreign ore.				
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Value.
1915	176,612,208	$7,928,518	77,236,303	$2,738,263	7,966,372	$353,235	$2,174,946
1916	200,999,835	13,494,065	19,760,086	1,111,653	10,341,075	689,043	2,522,957
1917	107,376,638	9,560,598	75,304,480	6,650,157	15,074,947	1,296,445	2,288,205
1918	83,662,322	5,889,381	118,832,344	8,309,798	6,852,173	350,851	1,828,473
1919	21,019,605	1,471,256	81,951,396	4,536,273	3,872,130	207,087	2,155,436
1920	5,459,713	462,223	34,725,501	2,570,535	12,350,794	536,322	3,621,397

[a] Exclusive of lead that entered as pig and was exported in the same form, which would be duplicated in exports of lead from foreign ore.

Pig lead exported from the United States, 1918–1920, by destination, in short tons.

Destination.	1918		1919		1920	
	Domestic.	Foreign.	Domestic.	Foreign.	Domestic.	Foreign.
Canada	5,590	10,230	657	1,418	364	1,358
Great Britain	26,185	40,412	3,039	20,174	252	2,439
Netherlands			246	616	146	1,870
France	11	862	2,208	1,120	23	1,008
Italy	1,462	112				
Russia	299	115	5			
Japan	4,381	4,319	392	11,452	392	3,584
Other countries	3,903	3,366	3,963	6,196	1,553	7,104
	41,831	59,416	10,510	40,976	2,730	17,363

PRICES.

[See statement on p. 16a.]

LIME.

PRODUCTION.

Lime burned and sold in the United States, 1913 and 1915–1920.

Year.	Quantity (short tons).	Value.[a]	Average price per ton.	Number of plants in operation.
1913	3,595,390	$14,648,362	$4.07	1,023
1915	3,622,810	14,424,036	3.98	906
1916	4,073,433	18,509,305	4.54	778
1917	3,786,364	23,807,877	6.29	595
1918	3,206,016	26,808,909	8.36	496
1919	3,330,347	29,448,553	8.84	539
1920	3,570,141	37,543,840	10.52	515

[a] The value given represents the value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Hydrated lime manufactured and sold in the United States, 1913 and 1915–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.	Number of plants in operation.
1913	493,269	$2,205,657	$4.47	80
1915	581,114	2,457,602	4.23	84
1916	717,382	3,626,998	5.06	89
1917	709,157	4,643,004	6.55	90
1918	620,216	5,342,113	8.61	90
1919	777,408	7,061,146	9.08	93
1920	853,116	9,287,562	10.89	98

IMPORTS.

Lime imported and entered for consumption in the United States, 1911–1920.[a]

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	5,232	$55,255	1916	7,959	$71,663
1912	4,268	48,153	1917	7,353	70,505
1913	4,139	48,538	1918	6,650	73,458
1914	3,455	33,670	1919	8,679	128,519
1915	1,956	22,489	1920	22,688	392,137

[a] Most of the lime imported into the United States comes from Canada.

EXPORTS.

Lime exported from the United States, 1913–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.	Year.	Quantity (short tons).	Value.	Average price per ton.
1913	29,475	$212,345	$7.20	1917	18,794	$168,671	$8.97
1914	24,141	170,744	7.07	1918	7,191	105,803	14.71
1915	16,223	106,312	6.55	1919	6,372	108,370	17.01
1916	23,973	132,769	5.54	1920	5,921	128,296	21.67

LITHIUM MINERALS.

PRODUCTION.

Lithium minerals produced in the United States, 1911–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	500	$9,000	1916	619	$12,035
1912	360	6,800	1917	2,062	42,912
1913	530	14,900	1918	5,894	111,600
1914	525	8,000	1919	6,287	115,000
1915	486	9,867	1920	11,696	173,002

IMPORTS AND EXPORTS.

Imports and exports of lithium minerals are not reported separately.

LITHOGRAPHIC STONE.

PRODUCTION.

During 1913 and 1914 small quantities of lithographic stone were quarried at Brandenburg, Meade County, Ky. No domestic production was reported for 1915. Statistics of production are available since 1916 only.

Lithographic stone produced in the United States, 1916–1920.

Year.	Quantity (pounds).	Value.
1916	40,000	$1,500
1917	5,832	489
1918	6,000	350
1919	0	0
1920	0	0

IMPORTS.

Value of lithographic stone imported for consumption in the United States, 1911–1920.

Year.	Value.	Year.	Value.
1911	$106,232	1916	$749
1912	88,994	1917	.....
1913	70,984	1918	.....
1914	46,043	1919	216,293
1915	8,870	1920	63,733

EXPORTS.

All lithographic stone produced in 1918 was exported to Japan.

MAGNESITE.

PRODUCTION.

Crude domestic magnesite sold or treated in the United States, 1913 and 1915–1920.

Year.	California.		Washington.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	9,632	$77,056	.....	.....	9,632	$77,056
1915	30,499	274,491	.....	.....	30,499	274,491
1916	154,259	1,388,331	715	$5,362	154,974	1,393,693
1917	211,663	2,116,630	105,175	783,188	316,838	2,899,818
1918	84,077	761,811	147,528	1,050,790	231,605	1,812,601
1919	50,020	504,973	106,206	743,442	156,226	1,248,415
1920	81,782	1,083,262	221,985	1,664,888	303,767	2,748,150

World's production of magnesite, 1917–1919, in metric tons.

Country.	1917	1918	1919
Australia	9,606	4,157	9,767
Austria-Hungary	[a] 106,783	(b)	(b)
Canada	57,397	52,276	18,968
Greece	162,938	39,340	29,885
India	18,493	5,947	17,401
Italy	31,070	28,882	35,930
Spain	800	1,700	120
Transvaal	709	756	929
United States	287,429	210,107	141,725
Venezuela	1,700	.....	.....
	676,925	343,165	254,725

[a] Exports, computed as crude. [b] No figures available.

IMPORTS.

Magnesite imported for consumption in the United States, 1918–1920.

	1918		1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Calcined, not purified	19,049	$824,022	9,471	$270,721	14,780	$373,165
Crude	5,432	103,233	6,381	103,311	33,550	406,204

EXPORTS.

Exports are negligible and are not recorded.

MAGNESIUM.

PRODUCTION.

Metallic magnesium produced in the United States, 1916–1920.

Year.	Number of producers.	Quantity (pounds).	Value.	Average price per pound.	
				Stick.	Powder.
1916	4	75,400	$311,462	$4.13	.....
1917	5	115,813	233,626	2.02	.....
1918	4	284,118	615,217	1.81	$2.67
1919	3	127,465	247,302	1.83	2.85
1920	2	(a)	(a)	1.60	2.75

a Only 2 producers and Survey not at liberty to show figures.

IMPORTS.

During 1920, 29,275 pounds of magnesium, valued at $25,055, was imported, compared with 13,239 pounds, valued at $13,583, in 1919. During the last six months of 1918 the imports were 11,899 pounds, valued at $16,259. Prior to 1915 the entire domestic supply was imported, but such imports are not separately shown until July, 1918.

EXPORTS.

No separate record of exports of magnesium is kept.

MANGANESE.

SUPPLY.

Manganese alloys and ore produced in the United States and imported from important foreign sources, 1913 and 1915–1920, in long tons.

Year.	Steel.	Ferromanganese.		Speigeleisen.		Manganese ore.				
	Production.[a]	Shipments.	Imports.	Shipments.	Imports.	Shipments.	Total imports.	Imports from.		
								Russia.	India.	Brazil.
1913	31,300,874	119,495	128,070	106,980	77	4,048	345,090	124,337	141,587	70,200
1915	32,151,036	144,260	55,263	114,556	200	9,613	320,778	.....	36,450	275,579
1916	42,773,680	224,103	90,928	182,837	.....	31,474	576,321	.....	51,960	471,837
1917	45,060,607	260,225	41,969	189,241	3,968	129,405	629,972	.....	48,975	512,517
1918	44,462,432	306,076	27,168	263,861	1,969	305,869	491,303	.....	29,275	345,877
1919	34,671,232	198,255	33,022	90,855	27	55,322	333,344	6,916	9,200	246,592
1920	42,132,934	276,594	59,254	103,672	5,234	94,420	606,937	18,762	71,238	421,523

[a] According to American Iron and Steel Inttitute.

PRODUCTION.

Manganese and manganiferous ore shipped from mines in the United States, 1913 and 1915–1920.

Year.	Ore containing 35 per cent of manganese or more.		Ore containing 10 to 35 per cent of manganese.		Ore containing 5 to 10 per cent of manganese.	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1913	4,048	$40,480	51,512	[a] $25,124	7,891	(a)
1915	9,613	113,111	180,953	796,981	14,782	$20,173
1916	31,474	656,278	453,853	1,787,429	90,473	189,201
1917	129,405	4,109,722	730,759	3,036,292	130,185	369,769
1918	305,869	8,240,386	916,163	4,603,790	254,299	1,031,789
1919	55,322	1,796,863	309,834	1,182,528	123,899	369,964
1920	94,420	2,396,235	481,249	1,783,133	286,415	654,665

[a] Value of ore containing 5 to 10 per cent manganese included in figures for ore containing 10 to 35 per cent. Figures not separable.

Manganiferous silver ore shipped from mines in the United States, 1913 and 1915–1920, in long tons.

Year.	Arizona.	Colorado.	Nevada.	New Mexico.	Utah.
1913	.....	49,753	.....	.....	.....
1915	1,452	30,921	104,498	.....	55
1916	7,392	106,863	122,429	.....	27
1917	32,009	124,715	122,872	.....	100
1918	10,854	124,041	80,096	475	.....
1919	1,964	40,824	77,815	250	.....
1920	345	45,726	95,142	541	.....

Manganiferous iron ore shipped from the Cuyuna district, Minn., 1913–1920, in long tons.

Year.	Ore containing 10 to 35 per cent of manganese.	Ore containing 5 to 10 per cent of manganese.	Year.	Ore containing 10 to 35 per cent of manganese.	Ore containing 5 to 10 per cent of manganese.
1913	26,200	.....	1917	359,542	91,590
1914	55,192	.....	1918	625,009	227,202
1915	42,973	.....	1919	138,952	98,220
1916	193,257	45,712	1920	293,524	248,913

Manganese ore produced in principal producing countries,[a] 1914–1920, in metric tons.

Country.	Percentage of manganese.	1914	1915	1916	1917	1918	1919	1920
North America:								
Canada	.....	25	182	868	143	399	600	[b] 841
Costa Rica	37–48	.....	.....	[b] 1,263	[b] 7,278	[b] 9,835	[b] 10,148	[b] 2,452
Cuba	36–44	.....	[b] 5,223	[b] 31,054	[b] 45,225	[b] 84,306	[b] 35,887	[b] 8,379
Mexico	40+	.....	.....	.....	73	2,878	2,294	839
Panama	50±	.....	.....	[b] 10,666	[b] 5,285	[b] 5,696	[b] 2	.....
Porto Rico	35+	.....	.....	[c] 749	[c] 1,208	[c] 1,372	[d]	[d]
United States	35+	2,677	9,767	31,978	131,482	310,778	56,210	95,935
South America:								
Brazil	38–50	[c] 183,630	[c] 288,671	[c] 503,130	[c] 532,855	[c] 393,388	[c] 205,725	[c] 453,737
Chile	40–48	.....	.....	.....	[b] 205	[b] 3,046	[b] 448	[b] 12,765
Europe:								
Austria	.....	13,808	11,926	[d]	[d]	[d]	5,267	[d]
Belgium	.....	.....	500	3,870	2,040	2,610	.....	.....
Bosnia and Herzegovina	.....	[d]	10,422	22,674	48,851	[d]	[d]	[d]
France	30+	6,393	10,324	10,807	11,589	9,871	7,016	5,697
Germany	30+	165	548	[d]	[d]	[d]	[d]	[d]
Hungary	.....	14,413	[d]	[d]	90,269	[d]	[d]	[d]
Italy	18–45	1,649	12,577	18,147	24,532	31,896	30,841	29,140
Russia	41–48	[e] 715,057	[e] 8,844	[e] 8,862	[d e]	[d e]	[d]	[d]
Spain	29+	13,155	14,328	14,178	57,474	77,714	66,685	21,256
Sweden	.....	3,724	7,733	9,048	20,027	16,648	12,400	[d]
United Kingdom	30+	3,492	4,714	5,222	10,101	17,736	12,272	13,082
Africa:								
Gold Coast	.....	.....	.....	[f]	[f]	30,777	35,754	44,310
Tunis	.....	.....	1,460	2,027	5,970	820	1,313	[d]
Asia:								
China	.....	.....	.....	.....	[b] 20	[b] 3,048	[b] 1	[b] 3,437
India	47–52	693,858	457,646	664,704	600,296	526,266	546,630	[d]
Japan	50+	17,067	25,871	49,310	51,374	[g] 29,759	[g] 22,877	[d]
Oceania:								
Australia	40+	26	556	1,292	290	9,034	5,049	[d]
Dutch East Indies	.....	.....	.....	.....	.....	1,450	2,915	4,179

[a] Figures are available for some years for Greece, New Caledonia, the Philippine Islands, and the Union of South Africa, but the production of none of these countries is sufficient to be included in this table.
[b] Imports into the United States. Production and exports not available.
[c] Exports.
[d] Not available.
[e] According to an article by D. Ghombashidze, F. R. G. S., delegate of the Georgian Government, in "The mineral resources of Georgia and Caucasia," manganese production in the Georgian Republic was 954,645 tons in 1913, 652,354 tons in 1914, 258,220 tons in 1915, 247,000 tons in 1916, 201,380 tons in 1917, and 150,000 tons in 1918.
[f] Shipments June, 1916, to November, 1917, 31,482 metric tons.
[g] Official figures covering all mines that produced over 375 metric tons. Unofficial figures for all mines were 59,000 metric tons for 1918 but are not yet available for 1919.

MANGANIFEROUS ZINC RESIDUUM.

PRODUCTION.

Unique deposits of zinc ore containing franklinite, willemite, zincite, calcite, and minor silicate and other minerals occur near Franklin Furnace, N. J. By mechanical and electromagnetic processes of separation three products are obtained from these ores,

one containing the greater part of the franklinite and the remaining two the other zinc minerals. The franklinite product is first roasted with anthracite to eliminate the zinc, which is recovered as zinc oxide, and the residue, containing about 15 per cent of manganese and 40 per cent of iron, is smelted to spiegeleisen.

No price is given for this material, as it is not sold in the open market, but is reduced to spiegeleisen by the company that produces it.

Manganiferous residuum produced from zinc roasting in the United States and shipped, 1919–1920.

Year.	Quantity (long tons).	Year.	Quantity (long tons).
1911	109,296	1916	198,817
1912	104,670	1917	155,332
1913	102,239	1918	146,796
1914	100,198	1919	80,418
1915	159,318	1920	133,602

MARL.

PRODUCTION.

Calcareous marl sold in the United States, 1916–1920.[a]

Year.	Quantity (short tons).	Value.	Average price per ton.
1916	58,088	$144,768	$2.49
1917	73,900	165,223	2.24
1918	98,694	261,082	2.65
1919	91,437	327,294	3.58
1920	97,487	322,339	3.31

[a] Figures not available prior to 1916.

IMPORTS AND EXPORTS.

No imports or exports of marl are reported.

MICA.

PRODUCTION.

Domestic mica sold in the United States, 1913 and 1915–1920.

Year.	Sheet mica.		Scrap mica.		Total.	
	Quantity (pounds).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	1,700,677	$353,517	5,322	$82,543	6,172	$436,060
1915	553,821	378,259	3,959	50,510	4,236	428,769
1916	865,863	524,485	4,433	69,906	4,866	594,391
1917	1,276,533	753,874	3,429	52,908	4,067	806,782
1918	1,644,200	731,810	2,292	33,130	3,114	764,940
1919	1,545,709	483,567	3,258	58,084	4,031	541,651
1920	[a]1,683,480	[a]546,972	5,723	167,017	[a]6,565	[a]713,989

[a] The figures for quantity and value of sheet mica in 1920 are not strictly comparable with those of any previous year, for the reason that they represent uncut sheet mica exclusively. In previous years the totals have included some cut sheet mica, and the cutting has the twofold effect of reducing the quantity and of increasing the value.

Mica produced and sold by chief producing States, 1915–1920.

State and year.	Sheet mica.			Scrap mica.		Total.	
	Quantity.		Value.	Quantity.	Value.	Quantity.	Value.
North Carolina:	*Pounds.*	*Short tons.*		*Short tons.*		*Short tons.*	
1915	281,074	141	$266,650	2,840	$33,943	2,981	$300,593
1916	546,553	273	380,700	2,755	41,880	3,028	422,580
1917	643,476	322	543,207	2,180	34,134	2,502	577,341
1918	941,200	471	460,450	1,046	12,930	1,517	473,380
1919	1,021,306	511	331,498	1,639	32,338	2,150	363,836
1920	1,084,946	542	405,654	2,823	91,653	3,365	497,307
New Hampshire:							
1915	96,685	48	59,414	516	7,557	564	66,971
1916	125,502	63	64,386	724	10,853	787	75,239
1917	472,519	236	159,822	680	9,229	916	169,051
1918	376,900	188	106,200	530	7,040	718	113,240
1919	235,724	118	90,915	738	13,356	856	104,271
1920	284,862	142	83,811	435	12,877	577	96,688
Georgia:							
1915	4,949	2	635	.....	.....	2	635
1916	16,037	8	2,094	.....	.....	8	2,094
1917	30,534	15	12,141	26	1,400	41	13,541
1918	208,200	104	77,300	40	2,750	144	80,050
1919	47,018	24	19,682	51	778	75	20,460
1920	50,095	25	13,692	101	3,015	126	16,707
Virginia:							
1915	10,808	5	9,590	63	828	68	10,418
1916	39,978	20	18,251	182	2,703	202	20,954
1917	68,558	34	22,831	253	2,709	287	25,540
1918	78,500	39	46,200	404	4,280	443	50,480
1919	(a)	(a)	(a)	578	7,811	(a)	(a)
1920	179,339	90	26,189	(a)	(a)	(a)	(a)
South Dakota:							
1915	25,992	13	8,230	179	2,684	192	10,914
1916	115,392	58	49,298	527	10,472	585	59,770
1917	37,523	19	5,975	272	5,033	291	11,008
1918	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1919	.....	.....	.....	(a)	(a)	(a)	(a)
1920	.....	.....	.....	(a)	(a)	(a)	(a)
Alabama:							
1915	8,400	4	5,545	23	395	27	5,940
1916	14,132	7	4,955	65	660	72	5,615
1917	18,476	9	3,528	12	280	21	3,808
1918	11,800	6	3,150	.....	.....	6	3,150
1919	(a)	(a)	(a)	.....	.....	(a)	(a)
1920	81,458	41	16,401	222	5,234	263	21,635

a Figures may not be published, as there were less than three producers.

World's production of sheet mica, 1913 and 1915–1919, in short tons.

Year.	United States.	India.	Canada.a	All other countries.b	Total.
1913	850	2,288	552	c 190	3,880
1915	277	1,357	209	c 58	1,901
1916	433	2,430	604	c 79	3,546
1917	538	2,291	583	c 218	3,730
1918	822	3,062	374	(d)	.....
1919	773	2,563	1,377	(d)	.....

a Estimated as one-half of the total reported production of mica in Canada.
b The total reported production of mica for the other countries.
c Incomplete, as no figures of production are available for some of the countries.
d No figures available.

World's production of scrap mica, 1913 and 1915–1919, in short tons.

Year.	England.[a]	United States.[b]	Canada.[c]	All other countries.[d]	Total.
1913	36,000	5,707	828	1,200	44,735
1915	[e]	4,088	504	707	.....
1916	[e]	4,649	906	1,255	.....
1917	[e]	5,748	873	[f] 1,200	.....
1918	[e]	2,772	550	[g]	.....
1919	[e]	3,643	2,066	[g]	.....

[a] All derived from the clay pits of Cornwall and Devon.
[b] The reported production plus one-half of the sheet.
[c] One-quarter of the total production reported. One-half of the reported production of mica in Canada is considered as sheet and the other half as scrap. One-half of the sheet probably eventually becomes scrap. This is an estimate for total scrap of three-quarters of the total reported production.
[d] One-half of the reported production of sheet. [e] No figures available. [f] Estimated.

Value of world's production of mica, 1913 and 1915–1919.

Year.	United States.	India.[a]	Canada.	Other countries.	Total.
1913	$468,060	$583,249	$164,304	$1,130,675	$1,826,288
1915	625,709	390,797	97,905	96,327	917,798
1916	594,381	337,608	253,239	82,137	1,446,425
1917	806,782	889,123	358,851	167,908	2,222,662
1918	784,440	777,820	377,350	[b]	.....
1919	947,831	1,408,258	270,788	[b]	.....

[a] Value given in official report in pounds sterling; conversion factor used, £1 = $4.8665.
[b] No figures available.

IMPORTS.

Mica imported for consumption in the United States, 1913 and 1915–1919.

Year.	Sheet.				Ground.		Total.	
	Unmanufactured.		Cut and splittings.					
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
1913	2,167,771	$772,382	[a]	$135,926	290,737	$4,765	[a]	$913,073
1915	621,452	246,449	[a]	46,962	344,940	6,858	[a]	692,269
1916	748,852	426,856	[a]	646,080	362,010	8,420	[a]	1,071,356
1917	626,185	464,882	[a]	1,014,281	96,963	1,044	[a]	1,480,188
1918	1,107,429	658,276	[a]	880,306	11,387	1,447	[a]	1,541,129
1919	740,713	708,252	[a]	702,228	62	9	[a]	1,488,709
1920	1,386,227	1,177,462	[a]	2,111,854	.....	.....	[b]	3,189,377

[a] Quantity not reported.

EXPORTS.

Mica exported from the United States, 1913 and 1915–1919.

Year.	Unmanufactured.		Manufactured.	Total value.
	Quantity (pounds).	Value.	Value.	
1913	398,770	$214,175	$48,009	$262,184
1915	84,250	5,128	93,915	99,043
1916	82,338	4,544	74,127	78,671
1917	[a] 111,377	3,251	71,442	74,693
1918	[b]	[b]	[b]	74,529
1919	[b]	[b]	[b]	106,948
1920	[b]	[b]	[b]	216,169

[a] For six months, January to June. [b] Unmanufactured and manufactured not separately stated.

MILLSTONES.

(See under Abrasive materials.)

MINERAL PAINTS.

PRODUCTION.

Domestic natural mineral pigments[a] sold in the United States, 1909–1919.[b]

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1909	60,220	$367,109	1915	7,197	$116,451
1910	64,629	427,730	1916	9,776	205,296
1911	64,738	448,921	1917	17,442	441,899
1912	74,957	561,180	1918	(c)	(c)
1913	77,197	577,980	1919	(c)	(c)
1914	7,197	116,451			

[a] Exclude white, umber, ocher, metallic paint, mortar color, and ground slate and shale.
[b] Factures discontinued after 1914.

Domestic zinc and lead pigments[a] made directly from ores, sold in the United States, 1911–1919.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	9,411	$1,145,795	1916	131,438	$23,111,800
1912	105,697	9,307,980	1917	145,039	24,473,137
1913	87,870	8,020,696	1918	102,740	20,494,980
1914	68,734	6,973,719	1919	127,748	21,913,671
1915	101,316	14,902,493	1920	150,344	24,564,173

[a] Include sublimed blue lead, sublimed white lead, basic sulphate white lead, zinc oxide, and zinc sulphide.

MINERAL WATERS.

PRODUCTION.

Domestic mineral waters sold in the United States, 1914 and 1916–1920.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average value per gallon (cents).
1914	456	17,487,394	$1,451,345	8
1916	473	16,113,961	1,339,744	8
1917	462	21,658,445	1,734,659	8
1918	417	16,748,613	1,301,713	8
1919	439	16,538,724	1,321,811	8
1920	457	14,867,296	1,236,140	8
1920	479	16,211,250	1,481,413	9

IMPORTS.

Mineral waters imported for consumption in the United States, 1913–1920.

Year.		Quantity (gallons).	Value.	Average price per gallon (cents).
1913		3,364,676	$955,788	28
1914		2,786,142	857,707	31
1915		1,528,181	551,648	36
1916		1,553,199	624,302	40
1917		618,405	268,665	43
1918	Natural and artificial—Jan.–June	258,791	123,695	49
	Natural [a]—July–Dec.	200,786	102,970	
	Artificial [a]—July–Dec.	29,910	14,976	
1919	Natural	193,933	112,732	58
	Artificial	9,081	4,216	
1920	Natural	466,547	177,992	39
	Artificial	60,567	25,909	

[a] Not separately shown prior to July, 1918.

EXPORTS.

Large quantities of a few domestic waters are exported, but no statistics regarding such shipments are available. The quantity and the value of these waters are included in the statistics of production for the United States.

MOLYBDENUM.

PRODUCTION.

So far as the United States Geological Survey has been able to ascertain, there was only one producer of molybdenum in the United States in 1920, the Molybdenum Corporation of America, at Questa, N. Mex. The closing of the mines was due to the lack of market.

Molybdenum in ore and concentrates produced and sold in the United States, 1914–1920.

Year.	Quantity sold (pounds).	Value.	Year.	Quantity sold (pounds).	Value.
1914	1,297	$1,297	1918	861,637	$1,253,700
1915	181,769	114,866	1919	297,926	341,814
1916	206,740	205,000	1920	34,900	17,207
1917	350,200	495,350			

World's output of molybdenum concentrates in terms of the contained molybdenum, 1916–1919.

[M=molybdenite; W=wulfenite.]

Country.	Ore mineral.	1916		1917		1918		1919	
		Quantity (metric tons).	Value.	Quantity (metric tons).	Value.	Quantity (metric tons).	Value.	Quantity (metric tons).	Value.
Australia	M	70.39	$314,800	102.05	$456,273	111.8	$500,000	140.87	$414,391
Austria	W	(a)	(a)	(a)	(a)	(a)	(a)	.....	.....
Bolivia	M	5.17	7,663	(a)	(a)	(a)	(a)	.....	.....
Canada	M	42.5	156,461	78.5	288,705	102.8	434,528	30.93	84,228
Chile	M	.8	.....	20.1	9,836	.....	.....	.....	.....
China	M	2.7	1,700	2.4	1,600	1.08	3,689	.....	.....
Chosen	M	3.2	12,463	59.2	19,034	10.7	25,884	.....	.....
Germany	M	(a)	(a)	(a)	(a)	(a)	(a)	.....	.....
India	M	.4	983	.7	3,050	.09	551	.09	492
Italy	M	.....	.....	.2	(a)	.....	.....	.....	.....
Japan	M	18.3	31,177	12.06	30,124	[b] 70.3	12,746	.....	.....
Norway	M	73.1	(a)	82.1	533,333	84.9	1,248,804	.....	.....
Peru	M	3.08	14,120	3.8	20,970	1.3	7,445	2.5	12,318
Sweden	M	.3	1,194	20.3	40,000	25.1	463,629	.....	.....
United States	M W	93.8	205,000	158.8	495,350	390.8	1,253,700	135.1	341,814

[a] Figures not available. [b] 54.7 metric tons coarse ore of low grade.

IMPORTS.

During 1920, 15,639 pounds of molybdenum ore, valued at $9,707, was imported into the United States, against 106,743 pounds, valued at $77,572, in 1919. No record of imports of molybdenum ores was kept by the Bureau of Foreign and Domestic Commerce before July 1, 1918. During the last six months of 1918, 140,222 pounds of ore, valued at $123,924, was imported. It is known that in the first half of the year 25,000 pounds of molybdenite, averaging about 75 per cent of MoS_2, was imported from Chosen and 19,000 pounds from some undesignated part of Asia. For imports of ferromolybdenum see under Ferroalloys.

EXPORTS.

Exports of ferromolybdenum are not separately classified.

NATURAL GAS.

[See Gas (natural).]

NICKEL.

PRODUCTION.

Prior to 1919 the United States produced no nickel from domestic materials except as a by-product of copper refining, as shown in the following table. In 1919, however, the production of nickel was begun from mixed ores mined on the property of the Missouri Cobalt Co. near Fredericktown, Mo. In 1920 the company produced 80,626 pounds of shot nickel and 256,767 pounds of nickel hydrate, though it did not operate during the whole year. Large quantities of nickel matte

imported from Canada and smaller quantities of matte from New Caledonian ore are, however, refined in the United States, though only Canadian matte was refined in 1920.

Nickel content of nickel salts and metallic nickel produced in the United States as a by-product in the electrolytic refining of copper, 1911–1920, and from mixed ores in 1919 and 1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	445	$127,000	1916	918	$671,192
1912	328	93,600	1917	402	331,556
1913	241	79,393	1918	441	401,000
1914	423	313,000	1919 [a]	511	434,485
1915	822	538,222	1920 [a]	365	293,250

[a] Including nickel produced from copper-lead-cobalt-nickel ores mined in Missouri.

IMPORTS.

Nickel imported for consumption in the United States, 1913 and 1915–1920.

Year.	Nickel, nickel ore, and matte, nickel oxide, and alloys of nickel with copper, etc.		Value of manufactured articles of nickel and nickel sheets and strips.	Total value.
	Quantity (pounds).	Value.		
1913	47,446,520	$6,562,555	$38,200	$6,600,755
1915	56,599,381	7,629,686	6,458	7,636,144
1916	72,649,377	9,899,340	25,880	9,925,220
1917	75,526,767	9,617,163	45,248	9,662,411
1918	73,207,147	11,520,775	115,243	11,636,018
1919	36,562,388	8,334,135	90,451	8,424,586
1920	48,492,076	10,657,193	200,464	10,857,657

Nickel imported for consumption in the United States, 1919 and 1920, by forms.

Form.	1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.
Nickel ore (nickel content)	10,431,602	$1,959,729	1,541,237	$145,723
Nickel matte (nickel content)	18,871,626	3,820,651	40,044,871	8,318,149
Nickel, alloys, pig, bars, etc	7,258,082	2,553,431	6,905,753	2,193,256
Nickel oxide	1,078	324	215	65
Nickel sheets and strips	10,152	4,889	.....	.....
All other manufactures	87,527	85,562	.....	200,464
	36,660,067	8,424,586	.....	10,857,657

Nickel ore and matte imported into the United States, 1919 and 1920, by countries.

[General imports.]

Country.	Nickel ore and matte.			Manufactures.	
	Quantity (short tons).	Nickel content (pounds).	Value.	Quantity (pounds).	Value.
1919.					
Australia	3,008	3,716,293	$760,887		
Canada	22,760	25,503,767	4,997,650	7,303,679	$2,580,695
China				3	2
Denmark				4	17
England				23,607	16,246
France				1,188	5,055
Germany				68	271
Japan				23,777	13,167
Netherlands				11	172
Oceania (French)	56	83,168	21,843		
Spain				10	10
Switzerland				3,414	28,247
	25,824	29,303,228	5,780,380	7,355,761	2,643,882
1920.					
Austria	1,210	1,396,001	361,698		5
Belgium	787	857,381	228,242		253
Canada	33,182	37,737,459	7,723,278		2,179,494
Chosen					109
Denmark					39
England					125,108
France					3,594
Germany					23,083
Japan					12,666
Netherlands					66
Oceania (French)	1,389	1,595,267	150,654		
Poland and Danzig					1,324
Sweden					2
Switzerland					49,959
Turkey in Asia					308
	36,568	41,586,108	8,463,872		2,396,010

EXPORTS.

Nickel, nickel oxide, and matte exported from the United States, 1911–1920.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1911	25,099,586	$8,283,777	1916	33,404,011	$12,952,493
1912	25,815,016	8,515,332	1917	21,992,820	8,936,620
1913	29,173,088	9,686,794	1918	17,469,500	6,927,041
1914	27,595,152	9,455,528	1919	3,810,656	1,697,544
1915	26,418,550	10,128,514	1920	1,215,232	574,845

OILSTONES AND SCYTHESTONES.

[See under Abrasive materials.]

PEAT.

PRODUCTION.

Crude air-dried peat used in the United States, 1913 and 1915–1920.

Year.	Fertilizer and fertilizer ingredient.		Stock food.		Fuel.		Other products.[a]		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	28,460	$169,600	4,800	$27,600	.....	.....	.....	.....	33,260	$197,200
1915	38,304	258,447	3,980	30,090	.....	.....	.....	.....	42,284	288,537
1916	48,106	336,004	4,300	32,250	(b)	(b)	100	$850	52,506	369,104
1917	92,263	658,500	5,100	51,400	.....	.....	.....	.....	97,363	709,900
1918	79,573	775,313	7,096	106,935	20,567	$164,745	25	250	107,261	1,047,243
1919	54,690	557,240	6,402	98,940	(b)	(b)	8,105	49,352	69,197	705,532
1920	63,272	773,635	c9,182	c143,047	750	5,050	(c)	(c)	73,204	921,732

[a] Peat moss, paper stock, and packing material. Also peat fuel in 1916 and 1919.
[b] Included under "Other products."
[c] Small quantity of miscellaneous products included under "Stock food."

IMPORTS.

Peat moss imported for consumption in the United States, 1913–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.	Year.	Quantity (short tons).	Value.	Average price per ton.
1913	10,983	$55,719	$5.07	1917	506	$4,966	$9.81
1914	9,921	57,542	5.80	1918	.....	.....	.....
1915	7,514	48,142	6.41	1919	464	16,345	35.23
1916	3,042	27,859	9.16	1920	2,762	36,201	13.11

EXPORTS.

No exports of peat are reported.

PETROLEUM.

PRODUCTION.

Petroleum produced in the United States, 1859–1920, by fields, in barrels of 42 gallons.

Year.	Appalachian.	California.	Lima-Indiana.	Rocky Mountain.	Illinois.
Prior to 1913	1,075,612,494	543,709,707	423,623,794	12,235,618	186,512,968
1913	25,921,785	97,788,525	4,773,138	2,595,321	23,893,899
1916	23,009,455	90,951,936	3,905,003	6,476,289	17,714,235
1917	24,932,205	93,877,549	3,670,293	9,199,310	15,776,860
1918	25,401,466	97,531,997	3,220,722	12,808,896	13,365,974
1919	31,830,000	101,183,000	3,486,000	13,383,000	11,960,000
1920	30,630,000	103,377,000	3,060,000	17,282,000	10,774,000
Grand total since production began	1,284,298,000	1,314,787,000	455,071,000	82,218,000	320,959,009

Petroleum produced in the United States, 1859–1920, by fields, in barrels of 42 gallons—Continued.

Year.	Mid-Continent.	Gulf.	Other.[a]	United States.
Prior to 1913	385,595,568	193,904,149	54,077	2,821,248,375
1913	84,920,225	8,542,494	10,843	248,446,230
1916	136,934,439	21,768,096	7,705	300,767,158
1917	163,506,205	24,342,879	10,300	335,315,601
1918	179,383,098	24,207,620	7,943	355,927,716
1919	193,147,000	23,366,000	12,000	378,367,000
1920	250,111,000	27,682,000	13,000	442,929,000
Grand total since production began	1,614,887,000	357,510,000	138,000	5,429,868,000

[a] Alaska, Arkansas, Michigan, Missouri, and New Mexico; also Utah in 1920.

Petroleum produced in the United States, 1919 and 1920, by States and fields.

State and field.	1919		1920	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.
California	101,183,000	$142,611,000	103,377,000	$178,395,000
Colorado	121,000	183,000	111,000	199,000
Illinois	11,960,000	29,720,000	10,774,000	39,583,000
Indiana	972,000	2,284,000	945,000	3,407,000
Kansas	33,048,000	77,026,000	39,005,000	133,469,000
Kentucky	9,278,000	24,597,000	8,738,000	34,279,000
Louisiana	17,188,000	26,803,000	35,714,000	112,606,000
Montana	90,000	171,000	340,000	1,045,000
New York	851,000	3,100,000	906,000	5,433,000
Ohio	7,736,000	23,333,000	7,400,000	37,338,000
Oklahoma	86,911,000	184,100,000	106,206,000	356,439,000
Pennsylvania	8,137,000	33,688,000	7,438,000	44,464,000
Tennessee	15,000	37,000	14,000	50,000
Texas	79,366,000	157,729,000	96,868,000	313,781,000
West Virginia	8,327,000	34,890,000	8,249,000	50,146,000
Wyoming	13,172,000	19,544,000	16,831,000	50,050,000
Other States [a]	12,000	50,000	13,000	61,000
	378,367,000	759,866,000	442,929,000	1,360,745,000
Appalachian	31,830,000	113,476,000	30,630,000	163,994,000
Lima-Indiana	3,486,000	8,453,000	3,060,000	11,123,000
Illinois	11,960,000	29,720,000	10,774,000	39,583,000
Mid-Continent	193,147,000	417,701,000	250,111,000	840,700,000
Gulf	23,366,000	27,957,000	27,682,000	75,595,000
California	101,183,000	142,611,000	103,377,000	178,395,000
Rocky Mountain	13,383,000	19,898,000	17,282,000	51,294,000
Other fields [a]	12,000	50,000	13,000	61,000
	378,367,000	759,866,000	442,929,000	1,360,745,000

[a] 1919: Alaska, Michigan, Missouri, and New Mexico; 1920: Alaska, Arkansas, Missouri, New Mexico, and Utah.

World's production of crude petroleum in 1919, by countries.

[Figures rounded.]

Country.	Barrels of 42 U. S. gallons.	Metric tons.	Cubic meters.	Percentage of total by volume.
United States	378,367,000	52,188,000	60,054,000	69
Mexico	87,073,000	12,964,000	13,843,000	16
Russia	25,498,000	3,477,000	4,053,000	5
Dutch East Indies	15,428,000	2,143,000	2,453,000	3
India	8,735,000	1,164,000	1,388,000	2
Rumania	6,614,000	920,000	1,051,000	1
Persia	6,412,000	875,000	1,019,000	1
Poland (Galicia)	6,054,000	829,000	963,000	1
Peru	2,616,000	349,000	416,000	
Japan	2,175,000	290,000	346,000	
Trinidad	1,841,000	256,000	293,000	
Egypt	1,501,100	231,100	239,000	
Argentina	1,183,000	172,000	188,000	
Venezuela	425,000	65,000	68,000	
Alsace	344,000	47,000	55,000	2
Canada	241,000	32,000	38,000	
Germany	234,000	33,000	37,000	
Italy	35,000	4,850	5,500	
Algeria	5,000	800	800	
England	1,900	250	300	
Other countries	750,000	110,000	119,000	
	545,533,000	76,151,000	86,629,600	100

STOCKS.

Pipe-line and tank-farm stocks of domestic petroleum held in the United States on December 31, 1919 and 1920, in barrels.

Field.	1919	1920
Appalachian	3,757,000	3,673,000
Lima-Indiana [a]	1,323,000	1,286,000
Illinois [a]	4,194,000	3,495,000
Mid-Continent	76,712,000	91,696,000
Gulf	12,575,000	12,311,000
Rocky Mountain	164,000	299,000
California	30,480,000	22,240,000
	129,205,000	135,000,000

[a] Southwest Indiana included with Lima-Indiana in 1919 and with Illinois in 1920.

IMPORTS AND EXPORTS.

Crude petroleum imported into and exported from the United States, 1913 and 1915–1920.

Year.	Imports.[a]		Exports.[b]	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.
1913	17,809,058	$12,947,280	4,630,229	$8,448,294
1915	18,140,110	10,389,012	3,768,168	4,282,827
1916	20,570,075	12,602,811	4,095,902	7,029,923
1917	30,162,583	16,400,017	4,098,124	7,668,312
1918	37,735,641	21,319,464	4,900,691	12,084,250
1919	52,821,567	26,442,881	5,924,320	14,805,546
1920	106,175,289	55,799,254	8,044,907	28,990,444

[a] Imports of crude petroleum into the United States are chiefly from Mexico, with small quantities from other countries.

[b] Exports of crude petroleum are chiefly to Canada. Exports of refined products are not included nor are shipments of crude petroleum to Alaska, Hawaii, Porto Rico, and the Philippine Islands.

PHOSPHATE ROCK.

PRODUCTION.

Phosphate rock sold in the United States, 1911–1920.

Year.	Quantity (long tons).	Value.	Year.	Quantity (long tons).	Value.
1911	3,053,279	$11,900,693	1916	1,982,385	$5,896,993
1912	2,973,332	11,675,774	1917	2,584,287	7,771,084
1913	3,111,221	11,796,231	1918	2,490,760	8,214,463
1914	2,734,043	9,608,041	1919	2,271,983	11,591,268
1915	1,835,667	5,413,449	1920	4,103,982	25,079,572

Phosphate rock mined and sold in the United States, 1919 and 1920, by States.

State.	1919			1920		
	Quantity (long tons).	Value.	Average price per ton.	Quantity (long tons).	Value.	Average price per ton.
Florida:						
Hard rock	285,467	$2,452,563	$8.59	400,249	$4,525,191	$11.31
Soft rock	14,498	196,318	13.54	13,953	190,551	13.66
Land pebble	1,360,235	5,149,048	3.79	2,955,182	14,748,620	4.99
	1,660,200	7,797,929	4.70	3,369,384	19,464,362	5.78
South Carolina:						
Land rock	60,823	308,968	5.08	44,141	367,209	8.32
Tennessee:						
Brown rock	[a] 475,475	3,123,565	6.57	[a] 556,177	4,425,761	7.96
Blue rock	58,550	290,951	4.97	78,671	518,234	6.59
	[a] 534,025	3,414,516	6.39	[a] 634,848	4,943,995	7.79
Western States [b]	16,935	69,855	4.12	55,609	304,006	5.47
	2,271,983	11,591,268	5.10	4,103,982	25,079,572	6.11

[a] Includes brown rock from Kentucky. [b] 1919: Idaho, Utah, and Wyoming; 1920: Idaho and Utah.

World's production of phosphate rock, 1913 and 1915–1919, in metric tons.

Country.	1913	1915	1916	1917	1918	1919
Algeria	377,934	[a] 225,891	[a] 389,211	[a] 234,825	[a] 198,539	276,040
Angaur Island	90,000	30,000	30,000	.....	.....	.....
Belgium	219,420	16,350	77,740	138,300	61,700	90,970
Canada [b]	349	197	184	135	127	22
Christmas Island	152,405	24,119	44,209	89,889	.....	.....
Dutch West Indies:						
Aruba	38,150	51,000	14,700	3,639	.....	.....
Curaçao	1,850	32,915				10,058
Egypt	104,450	82,998	125,008	115,732	31,147	29,364
France	298,859	145,000	24,700	.....	.....	103,869
French Guiana	3,193	.....	.....	.....	.....	.....
Japan, including Rasa Island	25,013	57,723	114,389	122,000	191,722	122,868
Makatea Island	82,056	71,724	39,285	114,780	.....	40,000
New Caledonia, Huon Island	2,100	8,400	.....	.....	.....	.....
New South Wales	2,032	.....	.....	.....	305	585
New Zealand	11,176	.....	.....	5,131	5,080	.....
Norway [b]	757	1,901	2,236	1,832	.....	.....
Ocean and Nauru Islands	250,000	.....	70,000	.....	.....	.....
Russia	25,000	.....	.....	.....	.....	.....
South Australia	6,045	4,688	5,093	5,183	8,204	6,045
Spain	3,548	9,080	14,111	28,148	43,303	25,035
Tunis	2,284,678	1,170,033	1,041,204	576,600	821,145	.....
United States	3,161,000	1,865,038	2,014,103	2,625,636	2,530,612	2,308,448
	7,140,015	3,797,057	4,006,173	4,061,830	.....	.....

[a] Exports. [b] Apatite.

IMPORTS.

Imports of phosphate rock are negligible.

EXPORTS.

Phosphate rock marketed in and exported from the United States, 1913–1920.

Year.	Marketed production (long tons).	Exports (long tons).	Proportion of exports to total sales (per cent).	Year.	Marketed production (long tons).	Exports (long tons).	Proportion of exports to total sales (per cent).
1913	3,111,221	1,366,508	44	1917	2,584,287	166,358	6
1914	2,734,043	964,114	35	1918	2,490,760	143,455	6
1915	1,835,667	253,421	14	1919	2,271,983	378,731	17
1916	1,982,385	243,678	12	1920	4,103,982	1,069,712	26

PLATINUM AND ALLIED METALS.

PRODUCTION.

REFINED NEW METALS.

Reports received from refiners of platinum, gold bullion, nickel, and copper indicate that 41,544 troy ounces of refined new metals of the platinum group were recovered in 1920, of which about 13,243 ounces are believed to be of domestic origin.

New platinum and allied metals recovered by refiners in the United States, 1915–1920, in troy ounces.

Year.	Platinum.	Iridium.	Iridosmine-osmiridium.	Palladium.	Other.
1915	6,495	274	355	1,541	.....
1916	24,518	370	315	2,885	.....
1917	33,009	210	833	4,779	.....
1918	54,399	465	539	4,024	326
1919	40,220	401	402	3,807	279
1920	36,015	418	409	4,309	393

SECONDARY METALS.

Refiners report recoveries in 1920 of 57,710 ounces of secondary platinum metals derived from refining scrap and sweeps. The figures that make up this total probably represent some duplication, as the same metal may be handled as scrap several times in a year.

Secondary platinum and allied metals recovered in the United States, 1915–1920, in troy ounces.

Year.	Platinum.	Iridium.	Palladium.
1915	42,149	863	958
1916	45,156	1,535	1,284
1917	59,007	9,832	3,347
1918	40,378	3,410	1,795
1919	54,545	3,504	3,467
1920	51,255	3,355	3,100

IMPORTS.

Platinum and allied metals imported for consumption in the United States, 1919–20.

Metal.	1919		1920	
	Quantity (troy ounces).	Value.	Quantity (troy ounces).	Value.
Platinum or crude platinum and unmanufactured products, ingots, bars, sheets, wire	54,550	$5,229,309	80,955	$8,474,499
Platinum, manufactured products, vases, retorts, etc.	22	[a] 17,213	781	[a] 94,408
Iridium	5,808	975,174	4,718	726,502
Osmiridium	1,374	112,403	4,473	450,241
Osmium	2,339	132,097	593	39,517
Palladium	3,739	250,777	6,944	612,248
Rhodium	222	30,474	2,053	217,385
Ruthenium	.....	.....	29	2,640
	68,054	6,747,447	100,546	10,617,440

[a] Includes articles to the value of $14,541 in 1919 and $15,711 in 1920, imported under duty, quantity not given.

EXPORTS.

Platinum exported from the United States, 1913 and 1915–1920.

Year.	Domestic.			Foreign.				
	Unmanufactured.		Manufactures.	Unmanufactured.		Manufactures.		
						Ingots, bars, etc.		Vases.
	Quantity (troy ounces).	Value.	Value.	Quantity (troy ounces).	Value.	Quantity (troy ounces).	Value.	Value.
1913	(a)	(a)	(a)	926	$29,510	265	$10,490	$10,000
1915	(a)	(a)	(a)	.....	.....	9	416	.....
1916	1,145	$97,988	$83,864	.....	.....	.....	3	.....
1917	3,445	234,433	65,415	.....	.....	11	1,200	.....
1918	119	13,511	23,562	.....	.....	.....	.....	.....
1919	522	75,066	54,529	.....	.....	.....	.....	.....
1920	1,302	177,115	111,014	.....	.....	.....	.....	.....

[a] Not separately classified prior to 1916.

POTASH.

PRODUCTION.

Potash produced and sold in the United States in 1919 and 1920, by sources.

Source.	Production.				Sales.		
	Number of producers.	Crude potash (short tons).	Available content of potash (K_2O).		Crude potash (short tons).	Available content of potash (K_2O) (short tons).	Value f.o.b. plant.
			Quantity (short tons).	Percentage of total.			
1919.							
Mineral:							
Natural brines—							
Nebraska lakes	10	36,176	9,072	27.9	95,276	23,908	$5,240,352
Other brines	7	[a] 37,395	[a] 12,518	38.6	25,677	10,584	2,744,963
	17	73,571	21,590	66.5	120,953	34,492	7,985,315
Alunite	7	6,599	2,294	7.1	6,599	2,294	718,506
Dust from cement mills	14	11,665	1,258	3.8	13,115	1,439	311,365
Silicate rocks and dust from blast furnaces	8	2,408	221	.7	2,328	214	48,021
Organic:							
Kelp and miscellaneous industrial waste	4	370	134	.4	370	134	37,274
Molasses distillery waste	6	8,791	2,892	8.9	8,541	2,802	801,533
Steffens waste water from beet-sugar refineries	11	[b] 12,423	[b] 3,601	11.1	13,313	3,847	1,081,053
Wood ashes	35	807	484	1.5	844	506	288,202
	102	116,634	32,474	100.0	166,063	45,728	11,271,269
1920.							
Mineral:							
Natural brines—							
Nebraska lakes	11	85,245	20,934	43.5	79,872	19,628	$3,755,084
Other brines	6	45,438	16,581	34.5	30,186	13,058	1,770,374
	17	130,683	37,515	78.0	110,058	32,686	5,525,458
Alunite and silicate rocks	3	4,311	2,127	4.4	4,018	2,006	457,576
Dust from cement mills	8	10,168	1,147	2.4	9,334	840	175,279
Dust from blast furnaces	9	2,203	173	.4	1,126	106	16,240
Organic:							
Molasses distillery waste and kelp	5	9,830	3,458	7.2	9,140	3,233	654,139
Steffens waste water from beet-sugar refineries	7	9,201	3,394	7.1	5,904	2,343	496,480
Wood ashes	17	438	263	.5	383	230	137,854
	66	166,834	48,077	100.0	139,963	41,444	7,463,026

[a] A considerable quantity lost through accident to plant.
[b] A large part of this material used privately.

STOCKS.

Potash held by producers in the United States at the end of 1920.

Source.	Crude potash.	Available content of potash (K_2O).
Mineral:		
Natural brines—		
Nebraska lakes	5,436	1,318
Other sources	21,081	5,869
	26,517	7,187
Alunite	315	132
Silicate rocks	864	300
Dust from cement mills	1,207	75
Dust from blast furnaces	940	315
Organic:		
Kelp	2,475	953
Molasses distillery waste	60	37
Steffens waste water from beet-sugar refineries		
Wood ashes		
	32,378	8,999

IMPORTS.

Potash materials imported and entered for consumption in the United States, 1913 and 1915–1920.

Year.	Potash salts used mainly in the fertilizer industry.[a]			Potash salts used mainly in chemical industries.[b]			Total.		
	Quantity (short tons).		Value.	Quantity (short tons).		Value.	Quantity (short tons).		Value.
	Gross weight.	Potash (K_2O) content.		Gross weight.	Potash (K_2O) content.		Gross weight.	Potash (K_2O) content.	
1913	1,053,684	255,101	$13,200,413	38,904	15,619	$4,873,452	1,092,588	270,720	$18,073,865
1915	100,256	42,519	3,257,114	16,430	6,348	3,001,234	116,686	48,867	6,258,348
1916	4,273	1,726	453,091	22,369	6,159	6,972,307	26,642	7,885	7,425,398
1917	1,165	504	189,159	24,122	7,596	7,599,247	25,287	8,100	7,788,406
1918	525	261	117,438	23,894	7,696	8,790,398	24,419	7,957	8,907,836
1919	127,416	28,484	4,163,739	33,430	11,135	6,028,077	160,846	39,619	10,191,816
1920	918,698	197,795	33,885,627	63,564	26,997	9,504,156	982,262	224,792	43,389,783

[a] Includes kainite, manure salts, muriate, and sulphate. Considerable quantities of muriate and some sulphate were used in chemical industries.

[b] Includes bicarbonate, bichromate, bitartrate, carbonate, caustic, chlorate, chromate, cyanide, ferricyanide, ferrocyanide, iodide, nitrate, permanganate, and Rochelle salt.

EXPORTS.

Domestic potash salts exported from the United States, 1919 and 1920.

Material.	1919			1920		
	Quantity (short tons).		Value.	Quantity (short tons).		Value.
	Gross weight.	Potash (K_2O) content.		Gross weight.	Potash (K_2O) content.	
Potassium chlorate	991	376	$524,193	1,410	535	$445,243
All other potassium salts	.....	.....	2,231,351	.....	.....	3,116,772
	.....	.....	2,755,544	.....	.....	3,562,015

PUMICE.

[See under Abrasive materials.]

PYRITES.

PRODUCTION.

Pyrites produced in the United States, 1911–1920.

Year.	Quantity (long tons).	Value.	Year.	Quantity (long tons).	Value.
1911	301,458	$1,164,871	1916	439,132	$2,038,002
1912	350,928	1,334,259	1917	482,662	2,593,035
1913	341,338	1,286,084	1918	464,494	2,644,515
1914	336,662	1,283,346	1919	420,647	2,558,172
1915	394,124	1,674,933	1920	310,777	1,596,961

IMPORTS.

Pyrites containing more than 25 per cent of sulphur imported for consumption in the United States, 1911–1920.

Year.	Quantity (long tons).	Value.	Year.	Quantity (long tons).	Value.
1911	1,006,310	$3,788,803	1916	1,244,662	$6,728,318
1912	970,785	3,841,683	1917	967,340	5,981,457
1913	850,592	3,611,137	1918	496,792	2,741,676
1914	1,026,617	4,797,326	1919	388,973	2,176,565
1915	964,634	4,817,977	1920	332,606	1,660,832

EXPORTS.

No exports of pyrites are reported.

QUICKSILVER.

SUPPLY.

Supplies of quicksilver in the United States, 1913 and 1915–1920.

[Flasks of 75 pounds.]

Year.	Production.		Imports for consumption.		Exports.		Apparent consumption.[a]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1913	20,213	$813,171	2,289	$75,361	1,140	$43,574	21,362	$844,958
1915	21,033	1,804,631	5,625	282,752	3,372	225,509	23,286	1,861,874
1916	29,932	3,768,139	5,659	515,919	8,880	670,475	26,711	3,613,583
1917	36,159	3,808,266	5,207	448,032	10,778	998,470	30,588	3,257,828
1918	32,883	3,863,752	6,719	533,622	3,098	338,620	36,504	4,058,754
1919	21,415	1,933,560	10,635	791,226	9,107	817,328	22,943	1,907,458
1920	13,392	1,066,807	14,169	971,510	1,553	129,993	26,008	1,908,324

[a] Production plus imports minus exports.

PRODUCTION.

Quicksilver produced in the United States, 1918–1920, by States.

[Flasks of 75 pounds.]

State.	1918		1919		1920	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Oregon	702	$82,485	435	$39,276	24	$1,912
Texas	8,451	992,992	5,019	453,166	3,436	273,712
California	22,664	2,663,020	15,205	1,372,859	9,849	784,571
Nevada	1,044	122,670	756	68,259	83	6,612
Idaho	22	2,585	.....	.....	.....	.....
	32,883	3,863,752	21,415	1,933,560	13,392	1,066,807

PRICES.

Average yearly prices of quicksilver in the United States and the United Kingdom, 1911–1920.

[Per flask of 75 pounds.]

Year.	San Francisco [a] (domestic).	New York.[b]	London.[c]	Year.	San Francisco [a] (domestic).	New York.[b]	London.[c]
			£ s. d.				£ s. d.
1911	$46.01	$46.54	8 4 11	1916	$125.89	$125.49	17 2 10
1912	42.05	42.46	8 2 10	1917	105.32	106.30	22 4 3
1913	40.23	39.54	7 9 2	1918	117.50	123.47	[d]
1914	49.05	48.31	[e] 7 15 0	1919	90.29	92.15	20 9 5½
1915	85.80	87.01	14 10 8	1920	79.66	81.12	20 14 9

[a] Min. and Sci. Press, San Francisco.
[b] Eng. and Min. Jour., New York.
[c] Min. Jour. (London).
[d] Quoted as "nominal" only.
[e] Metal exchange closed about three months after outbreak of war. Average based on 37 weeks only.

RADIUM.

[See under Uranium and vanadium ores.]

SALT.

SUPPLY.

Supplies of salt for consumption in the United States, 1900–1920, in short tons.

	1900	1910	1913	1919	1920
Domestic production	2,921,708	4,242,792	4,815,902	6,882,902	6,840,029
Imports	199,909	137,103	154,765	59,514	137,654
Total supply	3,121,617	4,379,895	4,970,667	6,942,416	6,977,683
Exports	7,511	49,013	70,289	119,416	139,272
Domestic consumption	3,114,106	4,330,882	4,900,378	6,823,000	6,838,411
Comparison with preceding year	+178,449	+6,444	+157,502	−319,251	+15,411
Percentage of imports to total consumption	6.4	3.2	3.2	0.9	2.0

PRODUCTION.

Domestic salt marketed in the United States, 1913 and 1915–1920.

Year.	Quantity (short tons).				Total value.	Average price per ton.
	Manufactured (evaporated).	In brine.	Rock salt.	Total.		
1913	2,131,229	1,622,382	1,062,291	4,815,902	$10,123,139	$2.10
1915	2,335,823	1,851,199	1,165,387	5,352,409	11,747,686	2.19
1916	2,454,836	2,539,717	1,368,353	6,362,906	13,645,947	2.14
1917	2,482,564	2,890,588	1,605,025	6,978,177	19,940,442	2.86
1918	2,724,203	2,830,600	1,683,941	7,238,744	26,940,361	3.72
1919	2,392,290	2,850,639	1,639,973	6,882,902	27,074,694	3.93
1920	2,409,924	2,819,916	1,610,189	6,840,029	29,894,075	4.37

SAND AND GRAVEL.

PRODUCTION.

Sand and gravel produced in the United States, 1913 and 1915–1920.

Year.	Glass sand.		Molding sand.		Building sand.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	1,791,800	$1,895,991	3,563,583	$2,230,217	25,397,383	$8,007,949
1915	1,884,044	1,606,640	3,585,746	2,123,203	22,921,426	6,884,267
1916	2,018,317	1,957,797	4,662,649	3,219,839	27,193,462	8,569,675
1917	1,942,675	2,685,014	4,660,968	4,303,809	25,374,987	9,837,688
1918	2,172,887	4,209,728	4,910,178	5,121,865	19,686,885	9,772,556
1919	1,827,409	3,593,371	3,774,612	4,153,990	21,969,736	12,296,664
1920	2,165,926	4,748,690	5,128,075	7,504,759	26,539,365	17,956,635

Year.	Other sand.		Gravel.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	7,941,389	$2,973,688	40,861,694	$9,109,663	79,555,849	$24,217,508
1915	7,550,773	2,558,991	40,661,314	9,948,516	76,603,303	23,121,617
1916	9,089,550	3,842,538	46,127,754	12,220,146	89,091,732	29,809,995
1917	8,866,876	4,962,232	35,573,819	13,508,189	76,419,325	35,296,932
1918	6,349,870	5,259,620	28,704,606	13,563,310	61,824,426	37,927,079
1919	8,397,979	6,345,654	34,606,671	19,561,877	70,576,407	45,951,556
1920	9,942,776	8,988,530	38,265,246	26,462,991	82,041,388	65,661,605

IMPORTS AND EXPORTS.

Value of sand and gravel imported into and exported from the United States, 1913–1920.[a]

Year.	Imports.	Exports.	Year.	Imports.	Exports.
1913	$172,257	(b)	1917	$142,586	$494,251
1914	139,675	(b)	1918	91,465	619,414
1915	96,754	(b)	1919	126,586	382,070
1916	87,144	$233,310	1920	912,282	669,945

[a] These imports and exports are mostly building sand shipped from and to Canada.
[b] Not reported separately.

SAND-LIME BRICK.

PRODUCTION.

Sand-lime brick sold in the United States, 1911–1920.

Year.	Number of operators reporting sales.	Quantity (thousands).	Value of product.	Year.	Number of operators reporting sales.	Quantity (thousands).	Value of product.
1911	66	142,963	$897,664	1916	53	227,344	$1,474,073
1912	71	178,541	1,200,223	1917	47	187,546	1,420,330
1913	68	189,659	1,238,325	1918	42	98,399	883,929
1914	62	172,629	1,058,512	1919	35	146,947	1,705,163
1915	56	179,643	1,135,104	1920	37	169,761	2,490,283

IMPORTS AND EXPORTS.

Imports and exports of sand-lime brick are not reported separately.

SELENIUM.

PRODUCTION.

Most of the selenium produced is a by-product in the electrolytic refining of copper.

Selenium produced in the United States, 1917–1920.

Year.	Quantity (pounds).	Value.
1917	39,630	$70,000
1918	103,694	206,540
1919	60,025	125,966
1920	92,141	175,508

IMPORTS.

Selenium and selenium salts imported for consumption in the United States, 1913–1920.

1913	$320	1917	$2,236
1914	43	1918	0
1915	59	1919	25,866
1916	302	1920	0

SILICA BRICK.

PRODUCTION.

Silica brick sold in the United States, 1911–1920.

Year.	Quantity (thousands).	Value of product.	Average price per thousand.	Year.	Quantity (thousands).	Value of product.	Average price per thousand.
1911	104,483	$2,520,816	$24.13	1916	232,673	$6,369,256	$27.37
1912	135,578	2,923,174	21.56	1917	327,030	15,510,595	47.43
1913	174,246	3,815,806	21.90	1918	336,562	19,987,803	59.39
1914	129,693	2,951,525	22.76	1919	211,420	10,914,898	51.63
1915	130,244	3,039,869	23.34	1920	250,582	15,076,821	60.17

IMPORTS AND EXPORTS.

Imports and exports of silica brick are not reported separately.

SILICA (QUARTZ).

PRODUCTION.

Silica sold for pottery, paints, fillers, polishers, abrasives, and other uses in the United States, 1918–1920.

Material.	1918		1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Quartz (vein quartz, pegmatite, and quartzite)	71,740	$259,330	63,332	$373,571	68,190	$320,350
Sand and sandstone [a]	98,956	620,584	47,277	288,890	158,395	1,183,014
Tripoli (ground and otherwise prepared)	19,982	199,854	24,292	181,541	49,233	569,677
Diatomaceous earth	[b] 2,965	[b] 24,947	42,642	531,960	61,922	1,079,693
	[b] 193,643	[b] 1,104,715	177,543	1,375,962	328,740	3,152,734

[a] Includes only finely ground material. Figures probably incomplete.
[b] Excludes in 1918 California diatomaceous earth used for filters and as insulating and fireproofing material, figures for which the Survey is not at liberty to publish.

IMPORTS AND EXPORTS.

No imports or exports of silica (quartz) are reported.

SILVER.

[See under Gold and silver.]

SLATE.

PRODUCTION.

Slate sold in the United States, 1913 and 1915–1920, by uses.

Year.	Roofing slate.			Mill stock.[a]			Other uses [a] (value).	Total value.
	Number of squares (100 sq. ft.).	Value.	Average price per square.	Quantity (square feet).	Value.	Average price per square foot.		
1913	1,113,944	$4,461,062	$4.00	6,312,011	$1,233,838	$0.195	$480,576	$6,175,476
1915	967,880	3,746,334	3.87	4,576,112	819,672	.179	392,909	4,958,915
1916	835,873	3,408,934	4.08	5,782,842	1,177,260	.20	752,643	5,338,837
1917	703,667	3,411,740	4.85	5,478,151	1,277,249	.23	1,060,977	5,749,966
1918	379,817	2,219,131	5.84	4,841,133	1,498,164	.31	1,123,825	4,841,120
1919	454,337	3,085,957	6.79	[a] 7,466,000	1,782,793	.24	[a] 1,161,898	6,030,648
1920	396,230	3,524,658	8.90	[a] 9,910,000	3,147,281	.32	[a] 2,054,503	8,726,442

[a] For 1919 and 1920 total output of millstock is given. Prior to 1919 bulletin, blackboard, and school slate material was included under "Other uses."

Slate sold in the United States, 1913 and 1916–1920, by States.

State.	1913	1916	1917	1918	1919	1920
Maine	$323,998	$342,474	$322,685	$287,891	$279,274	$450,561
Maryland	83,993	71,737	67,938	42,113	71,593	80,789
New York	144,882	21,345	55,207	323,558	450,379	911,293
Pennsylvania	3,733,581	3,124,743	3,306,704	2,304,647	2,885,072	3,850,267
Utah	.....	(a)	(a)	175	400	.....
Vermont	1,697,820	1,607,901	1,858,307	1,769,987	2,143,648	3,182,477
Virginia	175,830	165,483	135,380	109,723	200,282	251,055
Undistributed[b]	15,372	5,154	3,745	3,026	.....	.....
	6,175,476	5,338,837	5,749,966	4,841,120	6,030,648	8,726,442

[a] Included under "Undistributed."
[b] 1913: Georgia and New Jersey; 1916: California, New Jersey, and Utah; 1917: California, New Jersey, Tennessee, and Utah; 1918: California, New Jersey, and Tennessee.

IMPORTS.

Imports of slate are negligible, being valued at $4,512 in 1920 as compared with $691 in 1919, $321 in 1918, and $1,024 in 1917.

EXPORTS.

Roofing slate exported from the United States, 1913–1920.

1913	$226,413	1917	$27,113
1914	139,125	1918	65,224
1915	46,137	1919	55,164
1916	27,630	1920	122,105

Slate other than roofing exported from the United States, 1918–1920, by uses.[a]

Use.	1918		1919		1920	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
School slates, cases[b]	16,521	$111,680	13,763	$137,411	34,231	$321,290
Slate pencils, do	3,450	35,945	.....	.....	.....	.....
Electrical slate, square feet	33,883	35,478	41,485	26,991	54,038	44,248
Blackboards, do	12,287	2,590	34,841	7,605	32,322	10,726
Billiard tables, do	4,478	1,345	11,512	3,884	(c)	(c)
Structural, do	1,285	525				
	.....	187,563	.....	175,891	.....	376,264

[a] Statistics collected by Geological Survey from shippers.
[b] Cases weigh from 130 to 165 pounds each; average is 135 pounds.
[c] Statistics not tcollected for 1920.

SOAPSTONE.

[See under Talc and soapstone.]

SODIUM COMPOUNDS.

PRODUCTION.

Sodium compounds produced and sold in the United States, 1919 and 1920.

Product.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Sodium acetate	823	$121,167	1,080	$149,287
Sodium benzoate	126	230,224	201	365,841
Sodium bicarbonate	134,962	3,486,635	188,906	4,256,715
Sodium bichromate	26,526	6,233,566	25,973	5,531,954
Sodium bisulphite	a11,819	a687,750	22,059	1,028,373
Sodium bromide	499	493,319	543	523,724
Sodium carbonate:				
Soda ash	981,054	29,895,343	1,238,149	38,908,726
Monohydrate	31,278	714,930	2,267	115,256
Trona			10,609	343,911
Sal soda	80,090	2,229,994	62,857	2,128,937
Sodium chloride (common salt):				
Salt in brine	2,850,639	1,423,424	2,819,916	1,834,397
Rock salt	1,639,973	6,224,920	1,610,189	7,048,315
Evaporated salt	2,392,290	19,426,350	2,409,924	21,011,363
Sodium citrate, tartrate, and bitartrate	33	58,128	44	67,115
Sodium cyanide, peroxide, and nitrate (refined)	17,188	5,331,123	8,633	3,415,085
Sodium ferrocyanide	3,437	1,346,285	2,930	1,318,049
Sodium fluoride	674	168,960	934	210,782
Sodium fluosilicate	(b)	(b)	719	143,800
Sodium hydroxide	311,388	20,091,978	382,680	25,894,641
Sodium iodide	12	86,985	11	76,441
Sodium nitrite	1,182	265,121	1,197	405,184
Sodium phosphate	14,760	1,733,996	30,515	3,233,896
Sodium silicate	300,138	5,879,628	304,503	5,751,088
Sodium sulphate:				
Salt cake	129,042	2,019,460	178,770	2,049,102
Glauber's salt	47,730	877,060	50,655	990,541
Niter cake	83,402	271,424	308,638	788,544
Sodium sulphide	45,448	2,645,181	42,952	2,962,033
Sodium sulphite	(a)	(a)	3,778	197,782
Sodium tetraborate (borax)	28,518	4,351,891	35,281	5,674,012
Sodium thiosulphate	32,212	1,709,223	24,868	1,290,697
Miscellaneous sodium compounds (including metallic sodium)	1,338	832,282	4,508	891,793
	9,166,581	118,836,347	9,774,289	138,607,384

a Sodium sulphite included under "Sodium bisulphite" for 1919.
b Included under "Miscellaneous sodium compounds."

Sodium salts derived from natural sources in the United States, 1919 and 1920, by varieties.

Salt.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Sodium chloride (common salt):				
Salt in brine	2,850,639	$1,423,424	2,819,916	$1,834,397
Rock salt	1,639,973	6,224,920	1,610,189	7,048,315
Evaporated salt	2,392,290	19,426,350	2,409,924	21,011,363
Sodium carbonate, bicarbonate, sulphate, trona, and borax	29,120	874,083	42,683	1,513,179
	6,912,022	27,948,777	6,882,712	31,407,254

Crude borates produced in the United States, 1911–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	53,330	$1,569,151	1916	103,525	$2,409,459
1912	42,315	1,127,813	1917	108,875	3,609,632
1913	58,051	1,491,530	1918	88,794	2,263,230
1914	62,400	1,464,400	1919 a	66,146	1,380,000
1915	67,003	1,677,099	1920 a	120,320	2,173,000

a Including naturally occurring borax.

IMPORTS.

Sodium salts imported for consumption in the United States, 1919 and 1920, by varieties.

Salt.	1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.
Sodium arsenate			15,976	$1,481
Sodium benzoate	68,566	$14,435	33	17
Sodium bicarbonate [a]	17,122	3,616	5,828	593
Sodium carbonate:				
Soda ash	829,266	12,998	1,515,278	37,161
Monohydrate and sesquicarbonate			3,342	106
Sal soda	45,060	1,182	4,796	577
Sodium chlorate	39,022	3,814	561,513	50,266
Sodium chloride (common salt)	119,028,200	242,704	275,308,200	676,499
Sodium cyanide	5,174,831	305,426	7,590,495	1,091,443
Sodium ferrocyanide (yellow prussiate of sodium)	1,299,521	218,222	2,201,662	400,873
Sodium hydroxide or caustic soda	42,724	6,888	97,798	11,970
Sodium nitrate	912,932,160	19,558,963	2,961,038,080	63,121,035
Sodium nitrite	2,550,779	246,729	11,690,142	1,378,992
Sodium phosphate	56	22	66	19
Sodium silicate	931,086	25,421	658,658	15,162
Sodium sulphate, crude, or salt cake, and niter cake			230,720	2,833
Sodium sulphate crystals, or Glauber's salt			2,240	36
Sodium sulphide	1,668,562	54,251	1,038,181	47,064
Sodium sulphite	58,524	2,376	119,805	5,388
Sodium tetraborate, or refined borax	378	155	30,563	2,451
Sodium thiosulphate, or sodium hyposulphite	27,616	6,312	17,174	11,989
	1,044,713,473	20,703,514	3,262,130,550	66,855,955

[a] Or supercarbonate, or saleratus, and other salts containing 50 per cent or more of sodium bicarbonate.

EXPORTS.

Domestic sodium salts exported from the United States, 1915–1920.

1915	$7,725,034	1918	$22,291,735
1916	17,571,439	1919	18,545,420
1917	23,384,969	1920	27,191,439

Domestic sodium salts exported from the United States, 1919 and 1920, by varieties.

Salt.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Sodium bicarbonate			10,321	$616,261
Sodium carbonate:				
Soda ash	50,481	$2,656,608	83,381	4,689,591
Sal soda	5,563	178,285	6,015	220,487
Sodium chloride (common salt)	119,416	1,396,625	139,272	1,901,593
Sodium hydroxide	82,118	6,748,762	112,069	10,944,017
Sodium silicate	12,150	338,818	17,048	450,770
Sodium tetraborate (borax)			7,163	1,206,936
All other sodium salts		7,226,322		7,161,784
		18,545,420		27,191,439

Foreign sodium salts reexported from the United States, 1915–1920.

Year.	Sodium chloride (common salt).		Sodium cyanide.		Sodium nitrate.		All other sodium salts.
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Value.
1915	52	$31,841	949	$347,079	25,472	$1,123,761	$40,358
1916	7,448	61,525	111	58,265	60,079	3,432,273	193,086
1917	1,900	21,830	138	115,067	78,152	5,367,281	25,632
1918	723	13,903	(a)	145	61,271	5,204,413	73,402
1919	457	7,992	.....	.....	15,314	1,299,563	388,943
1920	418	6,252	78	12,123	21,593	1,448,226	98,386

a 125 pounds.

STEEL.

[See under Iron ore, pig iron, and steel.]

STONE.

PRODUCTION.

Stone produced and sold in the United States, 1913 and 1915–1920, by varieties.

Year.	Granite.		Basalt and related rocks (trap rock).		Sandstone.		Marble.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	(a)	$20,733,217	(a)	$9,134,494	(a)	$7,248,965	417,200	$7,870,890
1915	(a)	17,864,439	(a)	8,489,222	(a)	6,095,800	428,000	6,916,025
1916	9,270,800	17,456,838	10,233,640	7,666,297	4,681,590	5,603,778	409,970	7,033,171
1917	5,564,200	15,544,957	9,103,580	7,570,885	3,880,500	5,512,421	310,130	6,330,387
1918	3,827,400	14,466,423	6,859,200	7,782,280	2,858,100	4,529,298	305,720	5,496,389
1919	4,221,220	19,345,714	7,410,770	8,944,686	2,623,270	5,283,842	333,400	8,042,297
1920	4,760,000	24,954,908	9,219,200	12,260,148	3,343,000	7,310,290	431,500	11,069,585

Year.	Limestone.		Miscellaneous.b		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	(a)	$38,745,429	.....	.....	(a)	$83,732,995
1915	(a)	35,229,866	.....	.....	(a)	74,595,352
1916	67,235,000	41,309,599	.....	.....	91,831,000	79,069,683
1917	63,481,500	46,263,379	1,234,990	$993,642	83,574,900	82,215,671
1918	53,868,200	49,453,006	844,740	973,034	68,563,360	82,700,430
1919	49,759,800	53,171,701	1,190,540	1,920,903	65,539,000	96,709,143
1920	59,290,000	75,655,260	1,483,300	2,291,769	78,527,000	133,541,960

a Figures not available.
b Includes mica schist used for furnace lining, conglomerate, argillite, and various light volcanic rocks used mainly for crushed stone, which can not be properly classified in any of the main groups.

Stone produced and sold in the United States, 1919–20, by uses.

Use.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Building stone.....cubic feet..	12,764,516	$10,613,683	15,870,530	$18,948,588
Approximate equivalent in short tons.....	996,840	.....	1,266,380	.....
Monumental stone.....cubic feet..	4,759,995	15,042,369	4,549,430	17,488,765
Approximate equivalent in short tons.....	399,070	.....	383,910	.....
Paving blocks.....number..	35,630,885	2,590,690	35,959,200	2,898,459
Approximate equivalent in short tons.....	386,530	.....	389,980	.....
Curbing.....cubic feet..	1,826,663	1,288,828	1,508,480	1,297,058
Approximate equivalent in short tons.....	150,060	.....	127,710	.....
Flagging.....cubic feet..	962,173	502,871	688,890	463,718
Approximate equivalent in short tons.....	78,870	.....	56,460	.....
Rubble.....short tons..	601,146	818,565	501,570	791,177
Riprap.....do....	1,751,677	1,922,823	2,211,170	2,431,723
Crushed stone.....do....	33,673,339	36,405,186	40,365,860	50,846,693
Furnace flux (limestone and marble).long tons..	19,031,520	19,419,438	22,402,100	26,635,977
Equivalent in short tons.....	21,315,300	.....	25,090,350	.....
Refractory stone [a].....short tons..	1,060,741	1,429,775	1,735,440	2,393,537
Manufacturing industries (limestone and marble).....short tons..	4,370,936	5,179,387	4,592,280	4,591,559
Other uses.....do....	754,491	1,495,528	1,805,890	4,754,706
Total (quantities approximate, in short tons).....	65,539,000	96,709,143	78,527,000	133,541,960

[a] Ganister, mica schist, and dolomite.

IMPORTS.

Stone imported for consumption in the United States, 1918–1920.

Kind.	1918		1919		1920	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Marble:						
In blocks, rough, etc.....cubic feet..	96,478	$192,641	209,945	$593,340	468,845	$1,258,192
Sawed.....do....	.....	.....	9	90	102	922
Slabs or paving tiles.....square feet..	26,118	5,304	104,102	25,841	49,013	27,097
All other manufactures.....	.....	28,798	.....	46,622	.....	83,768
Mosaic cubes of marble and onyx:						
Loose.....	.....	5,508	.....	3,888	.....	18,221
Attached to paper.....	.....	.....	.....	974	.....	63
	.....	232,251	.....	670,755	.....	1,388,263
Onyx:						
In blocks, rough, etc.....cubic feet..	1,398	3,046	2,040	9,517	6,395	36,840
Slabs or paving tiles.....square feet..	.....	.....	.....	.....	4,200	4,009
All other manufactures.....	.....	133	.....	2,053	.....	2,960
	.....	3,179	.....	11,570	.....	43,809
Granite:						
Dressed.....	.....	1,328	.....	9,983	.....	108,193
Rough.....cubic feet..	18,473	9,653	23,240	17,796	43,805	42,162
	.....	10,981	.....	27,779	.....	150,355
Stone (other):						
Dressed.....	.....	5,060	.....	21,444	.....	17,622
Rough (monumental or building stone).....cubic feet..	11,995	12,716	13,807	14,228	110,940	98,327
Rough (other).....	.....	4,390	.....	42,185	.....	97,199
	.....	22,166	.....	77,857	.....	213,148
Grand total.....	.....	268,577	.....	787,961	.....	1,795,575

EXPORTS.

Stone exported from the United States, 1913 and 1916–1920.

Kind.	1913	1916	1917	1918	1919	1920
Marble and stone, unmanufactured	$606,745	$403,303	$572,097	$552,261	$770,392	$774,442
All other, manufactured	1,250,147	1,077,447	1,108,185	1,208,164	1,508,997	2,158,764
	1,856,892	1,480,750	1,680,282	1,760,425	2,279,389	2,933,206

STRONTIUM.

PRODUCTION.

Domestic strontium ore marketed in the United States, 1916–1920.

Year.	Quantity (short tons).	Value.
1916	250	$3,650
1917	4,035	87,700
1918	400	20,000
1919	0	0
1920	0	0

The Geological Survey has no record of the production of domestic strontium ore prior to 1916.

IMPORTS.

Value of strontium carbonate and strontium oxide imported for consumption in the United States, 1913–1920.

Year.	Value.	Year.	Value.
1913	$2,284	1917	$23,216
1914	1,016	1918	2,459
1915	6,411	1919	3,380
1916	11,049	1920	15,479

EXPORTS.

No exports of strontium ore have been reported.

SULPHUR.

PRODUCTION.

Sulphur produced and shipped in the United States, 1911–1920.

Year.	Mined.	Shipped.		Year.	Mined.	Shipped.	
	Quantity (long tons).	Quantity (long tons).	Approximate value.		Quantity (long tons).	Quantity (long tons).	Approximate value.
1911	205,066	253,795	$4,573,000	1916	649,683	766,835	$12,246,000
1912	787,735	305,390	5,289,000	1917	1,134,412	1,120,378	23,987,000
1913	491,080	319,333	5,617,000	1918	1,353,525	1,266,709	27,868,000
1914	417,690	341,985	6,214,000	1919	1,190,575	678,257	10,252,000
1915	520,582	293,803	4,959,000	1920	1,255,249	1,517,625	30,000,000

IMPORTS.

Sulphur imported and entered for consumption in the United States, 1913, 1915–1920.

Year.	Crude.		Flowers of sulphur.		Refined.		All other.[a]		Total.	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1913	15,122	$286,209	5,899	$115,574	1,234	$29,091	350	$17,690	22,605	$448,564
1915	24,647	405,990	647	23,146	988	30,335	85	12,987	26,367	472,458
1916	21,289	358,416	425	18,408	455	15,020	66	12,940	22,235	404,784
1917	973	20,176	.....	.....	.....	.....	42	9,164	1,015	29,340
1918	55	1,692	.....	.....	.....	.....	27	7,850	82	9,542
1919	77	1,997	.....	.....	.....	15	24	6,621	101	8,633
1920	44	1,722	.....	.....	50	2,530	42	22,576	136	26,828

[a] Includes sulphur lac and other grades not otherwise provided for, but not pyrite.

EXPORTS.

Sulphur exported from the United States, 1911–1920.

Year.	Quantity (long tons).	Value.	Year.	Quantity (long tons).	Value.
1911	28,103	$545,420	1916	128,755	$2,505,857
1912	57,736	1,076,414	1917	152,736	3,500,819
1913	89,221	1,599,761	1918	131,092	3,626,638
1914	98,163	1,807,324	1919	224,712	6,325,552
1915	37,312	724,679	1920	477,450	8,994,350

TALC AND SOAPSTONE.

TALC.

Domestic talc sold in the United States, 1913 and 1915–1920, by classes.

Year.	Rough (crude).		Manufactured into pencils and blanks.[a]		Ground.[b]		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	2,454	$11,597	138	$36,272	146,679	$1,232,151	149,271	$1,280,020
1915	8,235	58,867	39	11,941	158,062	1,330,389	166,336	1,401,197
1916	11,299	106,928	828	102,674	181,182	1,553,240	193,309	1,762,842
1917	12,269	68,440	5,781	176,404	180,563	1,644,828	198,613	1,889,672
1918	14,763	121,228	945	114,002	177,269	1,869,730	192,977	2,104,960
1919	15,625	73,437	921	147,339	151,793	1,601,736	168,339	1,822,512
1920	10,892	43,472	1,415	139,335	173,508	2,108,730	185,815	2,291,537

[a] Includes slate pencils and metal workers' crayons and blanks used in making acetylene burners and other objects.

[b] For foundry facings, filler for paper, paint, and rubber goods, toilet powder, foot ease, lubricators, for dressing skins and leather, etc.

World's production of talc and soapstone, 1913 and 1915–1919, by countries, in metric tons.

Country.	1913	1915	1916	1917	1918	1919
Austria [a]	[a] 16,000	[a] 12,000	[a] 12,000	[a] 12,000	(b)	(b)
Canada [c]	11,113	10,782	11,888	14,336	16,483	16,912
France [d]	60,175	(d)	(d)	(d)	(d)	35,600
Germany [e]	(b)	1,843	1,897	2,170	9,305	(b)
India [f]	2,565	1,094	1,233	7,955	13,191	2,169
Italy [g]	24,001	23,931	27,483	21,863	18,111	17,550
Norway [h]	1,500	2,990	5,500	7,084	15	.....
Spain [i]	4,407	963	3,561	3,450	3,328	3,024
Union of South Africa [j]	.....	40	120	712	608	687
United Kingdom [k]	41	864	306	1,253	951	699
United States	159,512	169,544	193,194	198,535	188,972	167,686
World's total (approximate)	279,314	.....	.....	.....	.....	244,327

[a] Statistics for Austria not available for years mentioned in table. Department of Commerce reports talc exported from Austria-Hungary in 1913 as 80,828 metric quintals, or 8,083 metric tons. Much talc is used in Austria, especially for paper. If we assume that somewhat less than half of the total output is used in Austria, the total production in 1913 was about 16,000 tons. As talc is rather a peace mineral and war delayed production, the cutput in 1915–1917, inclusive, would probably average less than 12,000 metric tons annually, although the capacity of the mines apparently is greater.

[b] Figures not yet available.

[c] Canada Dept. Mines, Mines Branch, Ann. Repts.

[d] 1913: Statistique de l'industrie minérale en France. Statistics from 1914–1918 not separately recorded. 1919: Information furnished by Director of Mines, Paris.

[e] Imperial Mineral Resources Bureau. Figures cover Bavaria only.

[f] 1913–1918: India Geol. Survey Rec.; 1919: Statistics furnished by Director of Geological Survey of India.

[g] 1913–1918: Rivista del servizio minerario; 1919: Revista minera, metalúrgica y de ingeniería, Año 72, No. 2769, 1921.

[h] Norges Officielle Statistik, Norges Bergverksdrift.

[i] Estadistica minera de España.

[j] Ann. Repts. Government Mining Engineer, Union of South Africa, Dept. Mines.

[k] Mines and quarries.

IMPORTS.

Talc imported for consumption in the United States, 1913 and 1915–1920.

Year.	Crude and unground steatite and French chalk.[a]			Talc, steatite, and French chalk—cut, ground, or washed.[b]			Total.	
	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.
1913	(c)	(c)	.....	(c)	(c)	.....	13,770	$137,680
1915	2,117	$12,967	$6.12	15,952	$186,873	$11.71	18,069	199,840
1916	2,027	12,645	6.24	16,855	218,230	12.95	18,882	230,875
1917	2,452	10,710	4.37	16,157	258,787	16.02	18,609	269,497
1918	1,434	9,253	6.45	12,735	251,323	19.73	14,169	260,576
1919	1,641	10,105	6.16	12,961	248,899	19.20	14,602	259,004
1920	941	7,206	7.57	21,739	443,514	20.40	22,680	450,720

[a] Duty free. [b] 15 per cent duty. [c] Not separately classified.

EXPORTS.

No exports of talc are reported.

SOAPSTONE.

PRODUCTION.

Domestic soapstone sold in the United States, 1913–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1913	26,562	$628,077	1917	20,235	$403,206
1914	21,208	524,213	1918	15,330	576,059
1915	20,555	490,385	1919	16,504	530,163
1916	19,652	490,961	1920	24,820	743,912

IMPORTS AND EXPORTS.

Imports and exports of soapstone are not separately reported.

TANTALUM.

For several years prior to 1918 there had been no market for tantalum or columbium minerals, and they had therefore not been produced. There had, however, been a continuously active interest in research in all lines of metallurgy, and as its name suggests this element has tantalized the investigator with its attractive qualities, such as resistance to the action of most acids and many other chemicals and of the air, its high tensile strength, malleability, and high melting point. In 1918 the demand for tantalum and columbium salts for experimental purposes became large enough to allow A. T. Roos, of Deadwood, S. Dak., to market 4,500 pounds of columbite, valued at $2,250. The columbite, which carried about 50 per cent Ta_2O_5, was taken from the pegmatite dike on the Bob Ingersoll claim, a few miles west of Keystone, S. Dak., on the road to Hill City, and from the Etta and other claims. In 1919 only 300 pounds, valued at $90, was shipped. In 1920 Dr. Roos shipped from various pegmatite dikes near Keystone and Custer, S. Dak., approximately 4,000 pounds of columbite at an average price of about 35 cents a pound.

No tantalum or "tantalum steel-hardening ores" were imported in 1920, and no separate record of exports is kept.

TELLURIUM.

Only one refiner, the Raritan Copper Works, reported a production of tellurium in 1920, as was also the case in 1919 and 1918, and the Survey is not at liberty to publish the figures. There continues to be a small demand for tellurium for experimental work, but the stocks are apparently large as compared with the annual consumption. Tellurium is a by-product from the electrolytic refining of copper.

Imports and exports of tellurium are not reported.

THORIUM MINERALS.

SUPPLY.

Monazite sand produced in the United States and monazite sand and thorium nitrate imported for consumption, 1913 and 1915–1920.

Year.	Monazite sand produced in the United States.		Imports of monazite sand.		Imports of thorium nitrate.		Price per pound of thorium nitrate.[a]
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	
1913	.....	.....	817,810	$65,848	119,044	$230,628	$2.73
1915	36,000	$3,600	1,873,971	161,456	67,247	170,268	[b] 4.50
1916	37,872	3,400	2,436,197	188,383	909	3,884	[b] 6.25
1917	22,000	1,760	5,828,270	355,017	1,188	2,359	[b] 8.00
1918	.....	.....	2,994,515	204,661	.....	.....	[b] 8.00
1919	(c)	(c)	632,568	48,768	3,307	5,250	[b] 3.75
1920	(c)	(c)	1,814,183	141,528	35,640	43,221	(d)

[a] The figures for 1915 to 1919 were kindly furnished by Dr. Hugo Lieber, 23 East Twenty-sixth Street, New York City.

[b] The prices ranged as follows: 1915, $3.75 to $6.00; 1916, $4,75 to $8.50; 1917, $7.00 to $8.00; 1918, $8.00 to $8.25; 1919, $3.75 to $8.00.

[c] Only one producer and Survey not at liberty to publish figures.

[d] Figures not yet available.

WORLD'S PRODUCTION.

World's production of monazite sand, 1913 and 1915–1919.

Year.	United States.		Brazil.		India.		Total.	
	Short tons.	Metric tons.	Short tons.	Metric tons.	Short tons.	Metric tons.	Short tons.	Metric tons.
1913	.....	.....	[a] 1,584	[a] 1,436	1,383	1,255	2,967	2,691
1915	18	16	[b] 484	[b] 439	1,241	1,126	1,743	1,581
1916	19	17	.....	.....	1,448	1,314	1,467	1,331
1917	11	10	1,252	1,136	2,173	1,971	3,436	3,117
1918	.....	.....	551	500	2,371	2,151	2,922	2,651
1919	(c)	(c)	(d)	(d)	2,266	2,056	.....	.....

[a] To France, Germany, and the United States.
[b] All to the United States.
[c] Only one producer and Survey not at liberty to publish figures.
[d] Figures not yet available.

EXPORTS.

No exports of thorium minerals are reported.

TIN.

PRODUCTION.

The metallic tin obtainable from ore mined in the United States in 1920 amounted to about 22 short tons, valued at about $22,000, as compared with about 56 tons in 1919, valued at $73,400. As in the past, practically all of the ore was won in Alaska.

World's production of metallic tin, 1913 and 1916–1919, in metric tons.

[Metal obtainable by smelting from concentrates.]

Country.	1913	1916	1917	1918	1919
Federated Malay States	50,930	44,570	40,470	37,970	37,460
British Protected Malay States	1,800	4,450	4,500	4,500	2,200
Bolivia	26,760	21,330	28,320	30,550	30,180
Banca	15,940	15,000	13,950	12,040	12,387
Billiton and Singkep	5,300	7,420	7,740	7,700	7,900
China	8,390	7,630	11,800	8,500	8,830
Siam	6,660	8,960	8,600	8,600	8,200
Nigeria	2,950	5,150	7,070	6,000	5,200
Australia	8,160	5,550	4,970	4,740	4,200
Cornwall	5,370	4,770	4,000	4,000	3,325
Union of South Africa	2,050	1,900	1,540	1,370	1,250
Other countries	1,400	1,700	1,800	2,000	2,000
	135,710	128,430	134,760	127,970	123,132

IMPORTS.

Tin imported as metal and entered for consumption in the United States, 1911–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	53,527	$43,346,394	1916	69,035	$51,802,232
1912	58,016	50,372,478	1917	72,166	63,860,340
1913	52,329	46,927,213	1918	71,254	93,144,218
1914	47,530	32,881,619	1919	44,849	50,890,019
1915	57,792	38,736,909	1920	62,795	73,440,872

Tin concentrate imported into the United States, 1915–1920.

[General imports.]

Year.	Quantity (short tons).	Value.
1915	552	$182,950
1916	8,040	4,032,460
1917	9,054	4,743,099
1918	18,394	11,444,401
1919	19,196	11,871,948
1920	34,148	18,795,162

Imports of tin concentrate were not separately listed before 1915. They were, however, negligible as no foreign tin ores were smelted before 1916.

EXPORTS.

Exports of metallic tin are insignificant, those of domestic manufacture amounting to 706 short tons in 1920, 306 tons in 1919, and 20 tons in 1918.

PRICES.

Average monthly prices, in cents per pound, of Straits tin in New York, 1919 and 1920.[a]

Month.	Average price per pound (cents).		Month.	Average price per pound (cents).	
	1919	1920		1919	1920
January	72.50	62.89	July	70.39	49.37½
February	72.00	60.00	August	63.78	47.69
March	71.75	61.99	September	55.81	44.62
April	72.26	62.20	October	55.62	40.64
May	71.94	55.07	November	54.17	37.02
June	71.20	48.62½	December	55.06	34.15

[a] Metal Statistics, 1921, p. 355.

Average yearly prices, in cents per pound, of Straits tin in New York, 1911–1920.[a]

1911	42.68	1916	43.48
1912	46.43	1917	61.65
1913	44.32	1918	86.80
1914	35.70	1919	65.54
1915	38.66	1920	50.36

[a] Metal Statistics, 1921, p. 353

TITANIUM MINERALS.

PRODUCTION.

During 1920, rutile (titanium dioxide, TiO_2) and ilmenite (titanium iron oxide, $TiFeO_3$) were produced in this country only by the American Rutile Co., at Roseland, Nelson County, Va.

Titanium minerals produced in the United States, 1913 and 1915–1920.

Year.	Rutile concentrates.		Ilmenite concentrates.		Total value.
	Quantity (short tons).	Percentage of TiO_2.	Quantity (short tons).	Percentage of TiO_2.	
1913	305	94–96	.....	.....	$49,000
1915	250	94–96	300	55	27,500
1916	110	95	95	55	18,400
1917	206	93	1,339	53–55	45,637
1918	261	95	1,644	53–55	57,750
1919[a]	102	94–96	106	48–50	22,520
1920	277	94–96	268	50	(b)

[a] Virginia production only; information regarding Florida not available for publication.
[b] Survey not at liberty to publish figures.

IMPORTS.

No titanium or "titanium steel-hardening ores" were imported during 1919 or 1920. The imports of such steel-hardening ores during the last six months of 1918 were 1,606 pounds, valued at $221. No separate record of similar imports was kept prior to July, 1918. For imports of ferrotitanium see under Ferroalloys.

EXPORTS.

No separate record of exports of titanium, "titanium steel-hardening ores," or ferrotitanium is kept.

TRIPOLI.

[See under Abrasive materials.]

TUNGSTEN.

SUPPLY.

Supplies of tungsten ores in the United States, 1916–1920, in short tons.

Year.	Production.	Imports.			Exports.[a]		Apparent consumption plus stocks on hand (accumulated during the year only).[c]
		Ore.	Tungsten and ferrotungsten.	Estimated equivalent in ore carrying 60 per cent of tungsten trioxide.[b]	Tungsten and ferrotungsten.	Estimated equivalent in ore carrying 60 per cent of tungsten trioxide.	
1916	5,923	4,072	43	4,522	287	646	9,799
1917	6,144	4,879	1	5,310	1,162	2,615	8,839
1918	5,061	11,609	.....	12,854	616	1,386	16,529
1919	327	9,408	198	10,915	19	43	11,199
1920	216	1,949	999	4,416	2	5	4,627

[a] No record of tungsten ore exported is at hand, although it is known that some has been shipped abroad.
[b] These items include the ore other than Chinese (considered as carrying 65 per cent of tungsten trioxide) and the tungsten and ferrotungsten (considered as equivalent to 2¼ times their weight in ore carrying 60 per cent of tungsten trioxide). Chinese ore imported has been considered as 67.5 per cent of tungsten trioxide.
[c] Production plus imports minus estimated equivalent in ore of the exports of tungsten and ferrotungsten.

PRODUCTION.

Only two operators are known to have produced tungsten ores in the United States during 1920, the Vasco Mining Co. and the Wolf Tongue Mining Co., both of which operate in the Boulder field, Colorado, and produce ferberite. Their output was equivalent to 232 short tons of concentrates carrying 60 per cent of tungsten trioxide. The figures are published through the courteous permission of both companies.

Concentrated tungsten ores (carrying 60 per cent tungsten trioxide) produced and sold in the United States, 1911–1920.

Year	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	1,139	$407,985	1916	5,923	$12,074,000
1912	1,330	502,158	1917	6,144	6,783,000
1913	1,537	672,118	1918	5,061	7,049,300
1914	990	435,000	1919	327	353,900
1915	2,332	4,100,000	1920	216	101,800

Concentrated tungsten ores (carrying 60 per cent tungsten trioxide) produced and sold in the United States, 1916–1920, by States, in short tons.

State.	1916	1917	1918	1919	1920
Alaska	47	32	14	.....	.....
Arizona	218	150	213	50	.....
California	2,171	2,781	1,791	147	.....
Colorado	2,401	2,707	1,910	130	216
Idaho	101	2	.....	.....	.....
Nevada	689	143	898	.....	.....
New Mexico	16	(a)	4	.....	.....
South Dakota	239	270	201	.....	.....
Other States [b]	41	59	30	.....	.....
	5,923	6,144	5,061	327	216

[a] Less than 1 ton.

[b] 1916: Connecticut, Missouri, Montana, Oregon, Utah, and Washington; 1917: Montana, Oregon, Utah, and Washington; 1918: Montana, Utah, and Washington.

World's production of tungsten ore, 1913 and 1915–1918, by metallogenic provinces and political areas, in metric tons of concentrates containing 60 per cent of WO_3.

Province and area.	1913	1915	1916	1917	1918
Asia.					
Japo-Korean province:					
Japan	257	389	730	763	629
Chosen (Korea)	.....	67	555	900	1,222
Chino-Malayan province:					
China	.....	35	109	1,361	10,577
Tonkin	127	333	343	433	378
Burma and Shan States	1,572	2,464	3,464	4,226	4,138
Siam	280	432	530	726	185
Unfederated Malay States	114	159	317	334	1,156
Federated Malay States	248	329	524	721	362
Dutch East Indies	6	6	47	8	27
Indian province:					
India (excluding Burma)	.....	.....	46	68	44
	2,604	4,214	6,665	9,540	18,718
Australia.					
Australian province:					
Queensland	533	642	456	471	357
Northern Territory	32	36	137	252	280
New South Wales	200	99	313	268	279
Victoria	1	.....	1	.....	5
South Australia	.....	.....	1	.....	.....
Tasmania	81	112	144	286	440
Western Australia	1	.....	.....	.....	6
	848	889	1,052	1,277	1,367
Oceania.					
Oceanic province:					
New Zealand	262	230	315	235	170
South America.					
Cordilleran province:					
Chile	.....	.....	9	2	.....
Argentina	575	169	854	1,056	632
Bolivia	297	859	3,288	4,215	3,703
Peru	324	413	532	427	256
Brazilian province:					
Brazil	.....	.....	5	.....	.....
	1,196	1,441	4,688	5,700	4,591
North America.					
Southwest American province:					
Mexico	.....	140	159	308	239
United States	1,394	2,116	5,330	5,545	4,578
Alaskan province:					
Alaska	.....	.....	43	29	13
Canadian province:					
Southeastern Canada	11	.....	.....	.....	15
	1,405	2,256	5,532	5,882	4,845
Europe.					
Scandinavian province:					
Norway	3	.....	1	1	.....
Sweden	.....	.....	.....	.....	3
Franco-Cornish province:					
England	197	360	407	245	307
France	160	126	162	261	45
Iberian province:					
Portugal	1,126	953	1,418	1,580	1,150
Spain	169	189	425	446	534
Italy	.....	.....	5	1	.....
Erzgebirgan province:					
Germany	96	193	330	300	300
Austria	52	14	10	10	10
Russian province:					
Russia	.....	.....	33	33	33
	1,803	1,835	2,791	2,877	2,382
Africa.					
South African province	5	1	3	12	54
	8,123	10,866	21,046	25,523	32,127

IMPORTS.

Tungsten-bearing ores imported into the United States, 1919 and 1920, by countries.[a]

[General imports.]

1919			1920		
Country.	Quantity (shorttons).	Value.	Country.	Quantity (shorttons).	Value.
Argentina	145	$111,489	Argentina	86	$64,284
Bolivia	545	213,793	Bolivia	158	85,726
Canada	20	12,750	Chile	148	74,906
Chile	985	685,414	China	420	142,572
China	2,810	1,624,539	Hongkong	859	276,842
Chosen	52	58,375	Japan	128	98,723
Colombia	1	1,312	Mexico	91	12,055
Hongkong	3,403	2,249,011	Panama	13	4,917
Japan	846	856,017	Peru	44	18,765
Mexico	114	104,529	France	1	353
Panama		172	"British Indies"	1	450
Peru	431	299,101			
Straits Settlements	56	44,688			
	9,408	6,261,190		1,949	779,593

[a] The ore from France probably originated in Portugal; that from Panama, Bolivia, Chile, Colombia, and most of that from Peru, is probably from Bolivia; that from China, practically all that from Hongkong, and half of that from Japan is probably from China.

For imports of tungsten and ferrotungsten see also under Ferroalloys.

EXPORTS.

No tungsten ore of domestic production was exported in 1920. For exports of tungsten and ferrotungsten see also under Ferroalloys.

PRICES.

Tungsten prices can be given only in a general way, for they are always more or less a matter of bargaining, and lots are sold on the same day at considerably different prices. Ores had little except speculative markets, and by the end of the year good scheelite ore, carrying 65 per cent of tungsten trioxide, was down to $3.50 a unit, and Chinese wolframite, carrying 65 to 72 per cent of tungsten trioxide, to $3.25 a short-ton unit.

URANIUM AND VANADIUM ORES.

PRODUCTION.

The output of uranium and vanadium ores in 1920 is estimated at 35,076 short tons containing 143.5 tons of uranium (338,240 pounds of U_3O_8), 526.7 tons of vanadium (1,819,535 pounds of V_2O_5), and about 43.4 grams of radium. The approximate value, as ore, was probably about $2,401,000. About 32.539 grams of radium in various salts was isolated during the year. The output of uranium and vanadium ores in 1919 amounted to about 14,509 short tons containing 28.96 grams of radium, 95.73 tons of uranium (225,704 pounds of U_3O_8), and 284.2 tons of vanadium. Any value given to the output must be arbitrary and open to question, for the larger part of the uranium ores was produced by companies that themselves used the

ores. Vanadium ore was produced at Placerville and Vanadium, Colo., by the Vanadium Corporation of America, which bought the mines and business of the Primos Chemical Co., and by the Colorado Vanadium Co. Owing to the very high price of vanadium, ores from the Paradox Valley and Gateway districts of Colorado and the La Sal Mountains, Utah, that ran high in vanadium but low in uranium, were shipped for their vanadium content.

More than half of the world's vanadium comes from Peru, and most of the remainder comes from the roscoelite and carnotite fields of southwestern Colorado and southeastern Utah. Small quantities of dechenite and other oxidized vanadium minerals have also been obtained in New Mexico, Nevada, and Arizona. A little mottramite has been mined in the former German East Africa, now under English control, and some ore has been reported from other parts of southern Africa; tyuyamunite, a calcium carnotite, has been mined in Russian Turkestan and treated at Petrograd; and vanadium has from time to time been extracted from the French iron slags.

The United States, as the largest steel-making nation, is the largest user of vanadium. England, Germany, and France buy ferrovanadium from this country and at times also buy ores.

The great patronite deposit at Minaragra, Peru, the largest known vanadium deposit, is owned by an American company, the Vanadium Corporation of America, but of course the political control is wholly in the hands of Peru.

The exports from Peru and the production in the United States since 1913 have been as follows:

Approximate world's production of vanadium, 1913 and 1915–1920.

Year.	Peru (exports of ore).			United States (production of ore and concentrates).
	Quantity (metric tons).	Percentage of V_2O_5.	Vanadium contained (metric tons).	Vanadium contained (metric tons).
1913				392
1915	3,145	45.58	793	569
1916	3,448	40.00	773	417
1917	4,083	35.78	819	439
1918	2,183	19.10	234	250
1919	2,947	30.41	502	258
1920	(a)	(a)	1,110	478

a Figures not yet available.

IMPORTS.

Uranium salts and oxide, including some radium salts, imported for consumption in the United States, 1913–1920.

Year.	Value.	Year.	Value.
1913	$34,319	1917	$2,930
1914	63,055	1918	a 274
1915	17,288	1919	b 12,960
1916	5,065	1920	3

a Radium salts only. In addition, 157 pounds of "uranium-radium steel-hardening ores," valued at $4,840 was imported.

b Composed of the value of 154 pounds of uranium salts and oxide ($1,309) and of 13 grains of radium salts ($11,651).

The imports of "vanadium steel-hardening ores" for consumption in the United States in 1920 were 20,673,296 pounds, valued at $1,080,935, and in 1919 were 6,026,005 pounds, valued at $67,846. Vanadium ore imported during the last six months of 1918 amounted to 1,772,215 pounds, valued at $5,333. No separate record was kept prior to July, 1918. The imports of "uranium-radium steel-hardening ore" in 1920 were 396 pounds, valued at $1,110. For imports of ferrovanadium see under Ferroalloys.

EXPORTS.

No separate record is kept of vanadium exports. For exports of ferrovanadium see under Ferroalloys.

PRICES.

The price of vanadium in ferrovanadium reached $8.50 a pound during the earlier part of 1920, but at the end of the year was nominally $6.50 to $7 a pound, depending on the silicon and other impurities present.

ZINC.

SUPPLY.

Supplies of primary zinc in the United States, 1913 and 1915–1920, in short tons.

	1913	1915	1916	1917	1918	1919	1920
Supply:							
Stock, Jan. 1—							
In bonded warehouses	48	111	32	90	32	.....	.....
At smelters	4,474	19,984	14,221	17,508	53,689	41,241	36,793
Production	346,676	489,519	668,343	669,573	517,927	465,743	463,377
Imports—							
Foreign	6,100	904	684	257	35	70	15
Domestic returned	.....	.....	.....	.....	.....	.....	8,162
Total available	357,298	510,518	683,280	687,428	571,683	507,054	508,347
Withdrawn:							
Exports, foreign, from warehouse	6,027	12,775	43,230	64,680	20,069	12,256	28,132
Exports, foreign, under drawback	7,459	32	.....	1,588	6,337	4,533	237
Exports, domestic	7,783	118,603	163,135	153,796	80,244	129,508	85,898
Stock, Dec. 31—							
In bonded warehouses	.....	32	90	32	.....	.....	.....
At smelters	40,659	14,221	17,508	53,689	41,241	36,793	71,037
Total withdrawn	61,928	145,663	223,963	273,785	147,891	183,090	185,304
Apparent consumption	295,370	364,855	459,317	413,643	423,792	323,964	323,043

PRODUCTION.

PRIMARY ZINC.

Primary zinc produced in the United States, 1913 and 1915–1920, by sources of ore, in short tons.

Source.	1913	1915	1916	1917	1918	1919	1920
United States	337,252	458,135	564,338	584,597	492,405	452,272	450,045
Foreign:							
Canada	1,424	5,103	24,376	6,787	8,700	4,007	1,583
Mexico	6,205	13,943	20,694	40,360	14,043	8,083	8,978
South America	.....	.....	6	.....	886	751	536
Europe	1,175	1,073	12,714	11,689	113	.....	.....
Africa	.....	.....	2,352	.....	.....	.....	.....
Asia	620	1,030	1,905	.....	.....	.....	.....
Australia	.....	10,235	41,958	26,140	1,780	630	2,235
Total foreign	9,424	31,384	104,005	84,976	25,522	13,471	13,332
Grand total	346,676	489,519	668,343	669,573	517,927	465,743	463,377

Primary zinc produced in the United States, 1913 and 1915–1920, by localities in which smelted, in short tons.

Location of smelter.	1913	1915	1916	1917	1918	1919	1920
Illinois	106,654	159,958	181,433	172,489	141,844	118,458	109,056
Kansas	74,106	101,423	141,286	76,048	29,149	43,942	41,044
Oklahoma	83,214	109,208	168,206	204,394	139,066	121,988	110,500
Other States	82,702	118,930	177,418	216,642	207,868	181,355	202,777
	346,676	489,519	668,343	669,573	517,927	465,743	463,377

Primary zinc produced in the United States from domestic ores, 1911–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	271,621	$30,964,794	1916	564,338	$151,243,000
1912	323,907	44,699,166	1917	584,597	119,258,000
1913	337,252	37,772,224	1918	492,405	89,618,000
1914	343,418	35,029,000	1919	452,272	66,032,000
1915	458,135	113,617,000	1920	450,045	72,907,000

The following statistics of the world's production of zinc, though incomplete, show approximately the foreign production during the war. The figures in black-faced type are taken from the official statistics of the countries named; those in the ordinary type are taken from statistical handbooks, consular reports, market letters, and trade journals. There is always a possibility of duplication in figures showing European production, for some countries send crude zinc of poor quality to other countries for refining. Furthermore, secondary zinc is included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in its production the domestic output of secondary zinc.

World's production of zinc, 1913 and 1915–1920, by countries where smelted, in metric tons.

Country.	1913	1915	1916	1917	1918	1919	1920
Australia:							
Mainland	4,187	5,393	5,362	4,769	5,712	3,625	3,909
Tasmania				49	3,883	3,727	5,911
Austria	21,707	9,472	11,642	12,633	12,012	(a)	(a)
Belgium	204,220	51,660	22,930	10,290	9,245	19,860	84,260
Canada		20	2,698	9,058	11,139	11,182	16,798
China	(a)	(a)	(a)	(a)	(a)	(a)	(a)
France	67,890	19,180	20,258	22,929	18,347	10,800	(a)
Germany:							
Upper Silesia	169,439	121,851	122,489	128,832	122,961	74,023	[b] 45,036
Other Germany	113,674	65,000	55,000	57,000	53,000	(a)	(a)
Great Britain	66,243	45,000	60,000	50,000	50,000	35,000	(a)
Italy			258	367	1,188	1,282	(a)
Japan	900	21,131	38,994	54,718	39,915	19,816	(a)
Netherlands	24,323	11,130	12,101	4,059	681		2,031
Norway	9,287	24,993	31,991	21,993	20,000	3,400	(a)
Russia	10,500	2,000	1,100	(a)	(a)	2,500	(a)
Siberia			213	569	(a)	(a)	(a)
Spain	6,003	8,117	8,523	10,155	15,900	16,314	(a)
Sweden	2,115	8,588	9,997	7,979	4,098	2,321	(a)
United States	314,498	444,082	606,307	607,423	469,853	422,513	420,366
Known output	1,015,000	838,000	1,010,000	1,003,000	838,000	627,000	

[a] Figures not yet available. [b] Figures cover January to June only.

SECONDARY ZINC.

Secondary zinc produced in the United States, 1913 and 1915–1920, in short tons.

	1913	1915	1916	1917	1918	1919	1920
Secondary zinc, redistilled	25,991	29,764	28,776	16,835	9,918	19,748	21,371
Secondary zinc, remelted	24,014	23,136	21,037	14,565	17,190	20,162	21,479
Secondary zinc recovered in alloys, excluding old brass remelted	3,743	5,300	2,600	4,800	11,082	6,062	7,650

IMPORTS.

Zinc ore imported into the United States, 1919 and 1920, by countries.

Country.	1919			1920		
	Ore (short tons).	Zinc content (short tons).	Value.	Ore (short tons).	Zinc content (short tons).	Value.
Canada	10,656	3,878	$115,974	4,731	1,794	$68,286
Mexico	33,443	11,225	346,040	47,453	14,975	497,459
Other countries	4,550	1,906	67,646	13,589	5,718	271,507
	48,649	17,009[a]	529,660	65,773	22,487	837,252

EXPORTS.

Zinc exported from the United States, 1918–1920, by classes.

Class.	1918		1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
DOMESTIC.						
Zinc ore	123,000	$2,480				
Zinc slabs and sheets	160,487,439	17,036,378	259,016,499	$22,736,155	171,795,629	$15,328,137
Zinc dross	31,631,364	2,238,913	10,245,628	739,295	4,890,963	316,637
Zinc manufactures		722,671		538,133		1,057,676
Brass, old, for remanufacturing	4,909,717	799,318	1,321,767	176,028	2,060,468	254,189
Brass, bars, plates, and sheets	30,989,717	9,522,934	7,770,671	2,310,561	5,810,733	1,671,608
Brass, articles made from		19,483,146		11,426,289		13,202,854
Cartridges		10,764,765		10,346,957		5,972,322
FOREIGN.						
Zinc, blocks, pigs, and old	40,138,715	3,565,127	24,512,265	1,943,507	56,262,876	4,331,636
Zinc dust	79,512	10,392	217,280	25,212		
Zinc manufactures				13,071		
Zinc used in articles exported with benefit of drawback	12,673,361	[a] 364,080	9,065,666	[a] 278,854	473,793	[a] 16,830
		64,510,204		50,534,062		42,151,889

[a] Declared value of the zinc used in making the articles exported with benefit of drawback.

Zinc and sheet zinc exported from the United States, 1918–1920, by destination, in short tons.

Destination.	1918		1919		1920	
	Domestic.	Foreign.	Domestic.	Foreign.	Domestic.	Foreign.
Canada	6,996	1,052	3,668	78	1,893	
Great Britain	28,334	6,908	53,978	5,511	47,307	22,080
Netherlands			3		114	
France	25,140	10,373	30,077	4,415	21,440	4,177
Italy	6,130	1,537	11,524	566	1,358	62
Russia						
Japan	5,287		18,562	1,481	2,784	698
Other countries	8,357	199	11,696	205	11,002	1,115
	80,244	20,069	129,508	12,256	85,898	28,132

PRICES.

[See statement on p. 16a.]

ZINC RESIDUUM.

[See under Manganiferous zinc residuum.]

ZIRCONIUM MINERALS.

PRODUCTION.

No zirconium minerals were produced in the United States from 1912 to 1920, inclusive. The early output of zircon in Norway and in North Carolina was used in the manufacture of incandescent gas mantles. Thoria and ceria have now entirely replaced zirconia in the manufacture of such mantles. The only zirconium mineral produced in the United States is zircon, almost all of which came from North Carolina. The zirconium minerals produced and exported from Brazil consist of the silicate, zircon, and the oxide, baddeleyite.

Zirconium minerals produced, 1911–1920.[a]

Year.	United States.		Brazil.			Year.	United States.		Brazil.		
			Quantity.						Quantity.		
	Quantity (short tons).	Value.	Metric tons.	Equivalent in short tons.	Value.		Quantity (short tons).	Value.	Metric tons.	Equivalent in short tons.	Value.
1911	[b]1½	$802	41	45	$16,169	1916			94	104	$16,647
1912			39	43	14,772	1917			(c)	(c)	(c)
1913			1,015	1,119	54,767	1918			(c)	(c)	(c)
1914			215	237	14,903	1919			(c)	(c)	(c)
1915			7	8	2,915	1920			(c)	(c)	(c)

[a] In addition to the quantities and values given in this table, zircon has been produced in very small quantity in different countries, including the United States, because of its value as a gem. The actual figures of production of gem zircon are not available.
[b] The exact quantity is 3,208 pounds.
[c] Figures not yet available.

IMPORTS.

The small imports of zirconium ore were not separately reported before July 1, 1918. For the six-month period, July to December, 1918, the imports of zirconium ore entered for consumption amounted to 3,216,659 pounds (1,608 short tons), valued at $77,250, an average value of $48 a ton. In 1919 the imports amounted to 11,023 pounds, valued at $332. None was imported in 1920.

EXPORTS.

Exports are negligible and are not recorded.

STATE TABLES.

Value of mineral production, 1916 to 1920, by States.[a]

State.	1916	1917	1918	1919	1920
Alabama	$40,922,462	$65,024,838	$77,795,572	$65,540,376	$86,289,575
Alaska	48,521,513	40,710,655	28,217,407	19,616,909	23,396,114
Arizona	192,622,991	212,615,978	203,992,915	112,512,239	116,355,415
Arkansas	9,508,001	12,061,702	14,081,691	10,709,213	17,065,428
California	137,284,754	175,399,036	204,673,547	213,823,488	269,424,325
Colorado	77,642,778	80,296,218	79,003,928	59,953,279	76,038,226
Connecticut	3,940,676	3,981,203	3,501,460	5,152,124	6,387,413
Delaware	336,172	523,991	372,804	390,706	359,833
District of Columbia	179,436	204,936	99,221	105,623	369,534
Florida	5,666,785	7,294,467	7,758,732	10,513,495	22,923,780
Georgia	6,779,828	7,650,553	8,312,051	9,429,972	12,178,695
Idaho	49,249,134	55,224,026	36,872,270	19,044,567	32,449,783
Illinois	146,359,792	234,735,962	271,244,365	213,701,212	373,926,090
Indiana	56,926,558	83,798,648	96,558,784	82,270,784	146,510,294
Iowa	30,210,284	39,336,372	38,742,009	37,882,183	57,250,480
Kansas	41,847,955	106,763,055	147,902,091	120,759,783	193,693,758
Kentucky	40,015,935	77,174,802	104,165,945	110,305,840	195,546,036
Louisiana	28,020,543	37,521,872	54,769,225	38,851,509	137,177,725
Maine	3,539,481	3,726,121	3,727,107	4,073,870	5,714,114
Maryland	13,335,013	19,617,596	20,866,706	18,345,024	31,155,798
Massachusetts	6,697,444	7,225,750	7,258,088	10,070,543	12,411,708
Michigan	140,666,124	163,997,853	158,312,121	122,973,774	166,338,868
Minnesota	113,662,522	152,490,554	155,412,823	131,529,797	177,589,967
Mississippi	890,566	966,135	925,192	1,628,031	2,201,246
Missouri	102,424,953	105,342,678	76,663,995	61,862,232	90,993,679
Montana	142,650,179	123,650,330	139,331,507	73,630,824	85,885,503
Nebraska	3,436,774	7,943,729	6,513,422	7,658,424	7,168,424
Nevada	53,510,559	55,408,057	51,080,169	24,457,735	25,648,961
New Hampshire	1,817,723	1,594,584	1,453,921	2,294,959	2,986,485
New Jersey	59,430,705	57,710,181	49,510,290	56,898,033	72,335,207
New Mexico	37,123,501	43,312,947	40,631,024	22,679,960	27,883,565
New York	45,619,119	52,123,552	52,768,877	56,379,564	78,078,505
North Carolina	4,595,551	5,246,391	4,973,386	6,223,953	7,760,482
North Dakota	1,283,809	1,749,549	1,823,109	2,413,025	3,078,648
Ohio	145,088,485	217,671,746	246,162,215	214,829,888	354,257,499
Oklahoma	169,556,331	259,134,377	336,857,921	291,078,174	490,115,359
Oregon	4,498,632	4,074,247	4,191,740	3,962,822	5,496,253
Pennsylvania	554,501,375	869,800,965	979,245,098	918,048,917	1,302,352,040
Rhode Island	789,208	717,123	760,787	853,981	1,175,653
South Carolina	1,392,073	1,393,297	1,558,543	2,370,916	2,825,479
South Dakota	8,696,680	8,348,684	7,441,981	5,842,704	5,951,138
Tennessee	28,277,365	36,910,448	39,229,614	37,134,899	55,023,452
Texas	47,711,571	75,958,481	110,306,367	190,563,015	369,708,979
Utah	99,734,209	113,433,596	105,785,474	64,165,525	76,536,657
Vermont	8,297,104	8,980,573	9,158,945	11,728,052	15,008,894
Virginia	20,560,956	32,243,648	37,639,368	36,799,407	60,161,247
Washington	14,521,014	18,576,052	20,999,691	18,267,938	26,677,191
West Virginia	187,043,011	306,916,191	327,962,620	298,168,194	511,813,037
Wisconsin	27,082,175	24,976,780	20,091,146	18,772,601	19,630,114
Wyoming	19,683,292	29,547,428	42,595,812	41,097,209	82,687,897

[a] In this table iron ore, not pig iron, is taken as the basis of valuation of iron, and in the case of other metals mine production (recoverable content of metals) is the basis.

Mineral production of Alabama in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons..	(a)	(a)	(a)	(a)
Bauxite.....long tons..	(a)	(a)	(a)	(a)
Cement.....barrels..	(a)	(a)	1,250,002	$2,849,378
Chert.....short tons..	(a)	(a)	.....	.....
Clay products.....	.....	$2,781,324	.....	3,422,146
Clay, raw.....short tons..	69,503	b 75,138	47,512	b 91,010
Coal.....do....	15,536,721	45,937,681	16,294,099	59,410,000
Coke.....do....	3,380,771	b 19,175,561	4,013,891	b 35,260,036
Ferroalloys.....long tons..	(a b)	(a b)	(a b)	(a b)
Fuller's earth.....short tons..	(a)	(a)	(a)	(a)
Gold.....troy ounces..	.....	.....	14	296
Graphite, crystalline.....pounds..	3,569,030	272,413	4,894,648	306,977
Iron ore.....long tons..	4,895,309	11,954,425	5,833,317	15,993,985
Iron, pig.....do....	2,044,937	b 53,092,133	2,339,939	b 76,520,797
Lime.....short tons..	135,095	1,062,542	151,595	1,175,518
Manganese ore.....long tons..	40	(a)	57	1,923
Manganiferous ore.....do....	.....	.....	150	(a)
Mica:				
Scrap.....short tons..	.....	.....	222	5,234
Sheet.....pounds..	(a)	(a)	81,458	16,401
Millstones.....	.....	(a)	.....	(a)
Mineral waters.....gallons sold..	4,694	1,548	1,461	916
Pyrites.....long tons..	(a)	(a)	.....	.....
Sand and gravel.....short tons..	785,479	400,338	886,337	485,639
Silver.....troy ounces..	.....	.....	9	10
Stone.....short tons..	945,910	1,465,733	1,355,170	2,544,334
Miscellaneous.....	.....	4,022,827	.....	2,209,391
Total value, eliminating duplications.....	.....	65,540,376	.....	86,289,575

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of Alaska in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Coal.....short tons..	60,674	$343,547	61,111	$356,000
Copper.....pounds..	47,220,771	8,783,063	70,435,363	12,960,106
Gold.....troy ounces..	455,984	9,426,032	404,684	8,365,560
Gypsum.....short tons..	(a)	(a)	(a)	(a)
Lead.....do....	687	72,822	875	140,000
Petroleum.....barrels..	(b)	(b)	(b)	(b)
Platinum and allied metals.....troy ounces..	569	73,663	1,113	120,366
Silver.....do....	629,708	705,273	953,546	1,039,365
Stone.....short tons..	(b)	(b)	(b)	(b)
Tin (metallic equivalent).....do....	56	73,400	16	16,112
Miscellaneous.....	.....	139,109	.....	398,605
Total value, eliminating duplications.....	.....	19,616,909	.....	23,396,114

a Calcined in Washington State. Value included under "Miscellaneous."
b Value included under "Miscellaneous."

Mineral production of Arizona in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	423	$219,950	1,200	$625,822
Clay products.....	.....	189,216	.....	163,329
Copper.....pounds..	538,100,844	100,086,757	558,256,302	102,719,160
Fluorspar.....short tons..	(a)	(a)	181	3,264
Gems and precious stones.....	.....	13,745	.....	5,328
Gold.....troy ounces..	217,998	4,506,413	231,529	4,786,122
Gypsum.....short tons..	(a)	(a)	(a)	(a)
Iron ore.....long tons..	.....	.....	950	(a)
Lead.....short tons..	5,102	540,763	7,300	1,167,981
Lime.....do....	10,905	138,062	12,990	184,850
Manganese ore.....long tons..	547	14,985	2,402	72,067
Manganiferous ore.....do....	1,964	(a)	345	(a)
Sand and gravel.....short tons..	(a)	(a)	13,275	8,428
Silica (quartz).....do....	(a)	(a)	(a)	(a)
Silver.....troy ounces..	5,266,605	5,898,598	5,355,303	5,837,280
Stone.....short tons..	566,610	399,271	431,390	329,264
Sulphuric acid [b].....do....	(a)	(a)	(a)	(a)
Tungsten ore (60 per cent concentrates)..do....	50	30,136	.....	.....
Vanadium ore.....do....	.....	.....	500	10,000
Zinc.....do....	859	125,341	729	118,041
Miscellaneous.....	.....	349,002	.....	324,479
Total value, eliminating duplications.....	.....	112,512,239	.....	116,355,415

a Value included under "Miscellaneous."
b From copper smelting. Figures for 1919 according to Bureau of the Census.

Mineral production of Arkansas in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Bauxite.....long tons..	333,490	$1,855,159	481,279	$2,897,892
Clay products.....	.....	a 1,229,296	.....	a 1,353,761
Clay, raw.....short tons..	.....	.....	(b c)	(b c)
Coal.....do....	1,429,020	5,288,844	2,103,596	9,592,000
Fuller's earth.....do....	.....	.....	(b)	(b)
Gems and precious stones.....	.....	(b)	.....	(b)
Iron ore sold for magnets.....long tons..	(b)	(b)	(b)	(b)
Lead.....short tons..	28	2,968	8	1,280
Lime.....do....	10,794	115,019	11,479	135,399
Manganese ore.....long tons..	2,558	60,633	3,445	93,077
Manganiferous ore.....do....	564	(b)	4,550	39,227
Marl, calcareous.....short tons..	(b)	(b)	(b)	(b)
Mineral waters.....gallons sold..	1,084,373	50,360	900,597	41,359
Natural gas.....M cubic feet..	5,586,822	949,800	d 6,815,000	d 1,159,000
Oilstones.....short tons..	349	126,408	209	120,671
Petroleum.....barrels..	.....	.....	(b)	(b)
Sand and gravel.....short tons..	871,328	406,802	909,007	554,003
Stone.....do....	408,830	547,646	e 643,000	e 908,969
Zinc.....do....	189	27,594	329	53,298
Miscellaneous.....	.....	48,684	.....	118,492
Total value, eliminating duplications.....	.....	10,709,213	.....	17,065,428

a Exclusive of pottery, value for which is included under "Miscellaneous."
b Value included under "Miscellaneous."
c Value not included in total value for State.
d Figures preliminary.
e Exclusive of marble, value for which is included under "Miscellaneous."

Mineral production of California in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	(a)	(a)	(a)	(a)
Asphalt.....do....	175,939	$2,958,511	246,695	$4,500,002
Barytes.....do....	(a)	(a)	2,250	20,850
Borates.....do....	66,146	1,380,000	120,320	2,173,000
Briquets, fuel.....do....	(a b)	(a b)	(a b)	(a b)
Calcium chloride.....do....	(a)	(a)	(a)	(a)
Cement.....barrels..	4,743,336	8,860,196	7,064,010	15,449,645
Chromite.....long tons..	3,272	80,463	1,416	33,687
Clay products.....	.....	5,834,648	.....	10,946,423
Clay, raw.....short tons..	141,174	b 235,971	214,799	b 437,078
Coal.....do....	(a)	(a)	(a)	(a)
Copper.....pounds..	21,732,507	4,042,246	12,626,272	2,323,234
Diatomaceous earth.....short tons..	40,200	486,840	(a)	(a)
Feldspar.....do....	(a)	(a)	1,144	24,436
Ferroalloys.....long tons..	(a b)	(a b)	.....	.....
Fuller's earth.....short tons..	.....	.....	(a)	(a)
Gems and precious stones.....	.....	9,221	.....	5,504
Gold.....troy ounces..	807,667	16,695,955	692,297	14,311,043
Graphite, crystalline.....pounds..	(a)	(a)	(a)	(a)
Gypsum.....short tons..	(a)	(a)	(a)	(a)
Iron ore:				
Sold to furnaces.....long tons..	2,053	13,796	6,592	44,844
Sold for paint.....do....	.....	.....	(a)	(a)
Lead.....short tons..	1,784	189,118	2,407	385,081
Lime.....do....	39,307	466,905	48,571	653,075
Lithium minerals.....do....	(a)	(a)	(a)	(a)
Magnesite.....do....	50,020	504,973	81,782	1,083,262
Manganese ore.....long tons..	11,289	329,200	1,733	53,285
Marl, calcareous.....short tons..	(a)	(a)	(a)	(a)
Mineral waters.....gallons sold..	2,693,165	365,997	2,674,086	326,295
Natural gas.....M cubic feet..	55,607,361	9,453,300	66,041,280	12,528,000
Natural-gas gasoline.....gallons..	40,385,796	5,744,867	48,207,976	8,323,819
Peat.....short tons..	(a)	(a)	9,927	77,614
Pebbles for grinding.....do....	(a)	(a)	(a)	(a)
Petroleum.....barrels..	101,183,000	142,611,000	103,377,000	178,395,000
Platinum and allied metals.....troy ounces..	503	73,711	448	72,034
Potash (K_2O).....short tons..	13,366	3,417,049	10,379	1,823,667
Pumice.....do....	(a)	(a)	650	12,710
Pyrites.....long tons..	128,803	530,678	128,114	519,078
Quicksilver.....flasks..	15,205	1,372,859	9,849	784,571
Salt.....short tons..	200,115	1,555,596	212,008	1,301,426
Sand and gravel.....do....	3,168,517	1,426,517	4,679,949	2,707,657
Sand and sandstone (finely ground).....do....	.....	.....	(a)	(a)
Sand-lime brick.....thousands..	.....	.....	(a)	(a)
Silica (quartz).....short tons..	(a)	(a)	(a)	(a)
Silver.....troy ounces..	1,107,189	1,240,051	1,706,327	1,859,896
Sodium salts (carbonate, bicarbonate, sulphate, and trona) from natural sources...short tons..	21,631	592,157	34,067	1,155,449
Stone.....do....	2,851,820	2,798,918	4,424,640	5,618,777
Sulphuric acid c.....do....	(a)	(a)	(a)	(a)
Talc.....do....	9,837	147,470	13,199	232,182
Tungsten ore (60 per cent concentrates)...do....	147	245,465	.....	.....
Zinc.....do....	236	34,528	583	94,406
Miscellaneous.....	.....	761,407	.....	1,790,475
Total value, eliminating duplications.....	.....	213,823,488	.....	269,424,325

a Value included under "Miscellaneous."
b Value not included in total value for State.
c From copper smelting. Figures for 1919 according to Bureau of the Census.

Mineral production of Colorado in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	$2,662,671	.....	$3,671,241
Clay, raw.....short tons..	138,706	b 139,308	131,797	b 172,378
Coal.....do....	10,323,420	28,748,534	12,278,225	42,829,000
Coke.....do....	613,753	b 4,383,169	789,499	b 6,661,534
Copper.....pounds..	3,560,207	662,198	4,043,734	744,047
Ferroalloys.....long tons..	5,022	b 783,767	(a b)	(a b)
Fluorspar.....short tons..	9,687	150,739	12,852	251,308
Gems and precious stones.....	.....	1,255	.....	1,090
Gold.....troy ounces..	478,266	9,886,627	366,504	7,576,319
Graphite, amorphous.....short tons..	(a)	(a)	(a)	(a)
Gypsum.....do....	(a)	(a)	(a)	(a)
Iron ore.....long tons..	4,278	(a)	1,914	(a)
Iron, pig.....do....	(a b)	(a b)	(a b)	(a b)
Lead.....short tons..	18,535	1,964,722	23,315	3,730,383
Lime.....do....	2,136	26,102	1,914	23,628
Manganese ore.....long tons..	11,166	238,671	3,643	52,545
Manganiferous ore.....do....	40,840	166,075	45,726	152,814
Mica, scrap.....short tons..	(a)	(a)	(a)	(a)
Mineral paints, zinc and lead pigments....do....	(a b)	(a b)	(a b)	(a b)
Mineral waters.....gallons sold..	391,851	81,087	227,208	67,538
Molybdenum.....pounds..	296,813	340,444	.....	.....
Natural gas.....M cubic feet..	10,170	1,900	8,470	1,430
Petroleum.....barrels..	121,000	183,000	111,000	199,000
Potash (K_2O).....short tons..	1,678	540,646	1,046	230,350
Pyrites.....long tons..	17,474	85,261	25,523	123,674
Sand and gravel.....short tons..	248,483	154,978	222,716	158,797
Silica (quartz).....do....	(a)	(a)	(a)	(a)
Silver.....troy ounces..	5,758,010	6,448,971	5,469,335	5,896,175
Stone.....short tons..	529,800	723,430	553,040	810,590
Tungsten ore (60 per cent concentrates)....do....	130	78,334	216	101,860
Uranium and vanadium ores.....do....	14,105	1,575,073	33,049	2,284,029
Zinc.....do....	18,610	2,717,096	24,395	3,952,050
Miscellaneous.....	.....	9,507,210	.....	15,426,067
Total value, eliminating duplications.....	.....	59,953,279	.....	76,038,226

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of Connecticut in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	$2,552,070	.....	$3,255,295
Clay, raw.....short tons..	.....	.....	(a b)	(a b)
Diatomaceous earth.....do....	(a)	(a)	(a)	(a)
Feldspar.....do....	10,880	133,113	8,645	125,153
Gems and precious stones.....	.....	.....	.....	971
Iron ore.....long tons..	5,384	(a)	3,700	(a)
Iron, pig.....do....	3,500	(a b)	1,698	(a b)
Lime.....short tons..	(a)	(a)	(a)	(a)
Mineral waters.....gallons sold..	1,216,184	61,150	1,275,451	72,797
Sand and gravel.....short tons..	261,815	212,286	341,371	279,557
Silica (quartz).....do....	(a)	(a)	(a)	(a)
Stone.....do....	1,288,650	1,505,748	1,284,440	1,796,724
Miscellaneous.....	.....	880,128	.....	979,115
Total value, eliminating duplications.....	.....	5,152,124	.....	6,387,413

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of Delaware in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products		$223,035		$279,005
Clay, raw, short tons	8,058	[a] 69,539	10,007	[a] 97,492
Sand and gravel, do	34,843	19,404	31,320	20,337
Stone, do	88,739	148,267	(b)	(b)
Miscellaneous				60,491
Total value, eliminating duplications		390,706		359,833

[a] Value not included in total value for State. [b] Value included under "Miscellaneous."

Mineral production of the District of Columbia in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products		[a] $61,394		[a] $60,880
Ferroalloys, long tons	(b c)	(b c)	(b c)	(b c)
Mineral waters, gallons sold	(b)	(b)		
Sand and gravel, short tons			(b)	(b)
Sand-lime brick, thousands	(b)	(b)	(b)	(b)
Stone, short tons	5,700	15,627	5,050	11,900
Miscellaneous		133,102		345,590
Total value, eliminating duplications		105,623		369,534

[a] Exclusive of pottery, value for which is included under "Miscellaneous."
[b] Value included under "Miscellaneous."
[c] Value not included in total value for State.

Mineral production of Florida in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products		[a] $185,135		[a] $312,150
Clay, raw, short tons	(b c)	(b c)	(b c)	(b c)
Fuller's earth, do	(b)	(b)	(b)	(b)
Lime, do	(b)	(b)	(b)	(b)
Mineral waters, gallons sold	192,935	12,062	268,470	27,120
Monazite sand, pounds	(d)	(d)	(d)	(d)
Peat, short tons	(b)	(b)	(b)	(b)
Phosphate rock, long tons	1,660,200	7,797,929	3,369,384	19,464,362
Sand and gravel, short tons	271,794	164,101	132,749	117,601
Sand-lime brick, thousands	(b)	(b)	(b)	(b)
Stone, short tons	129,030	185,531	340,470	430,130
Titanium minerals:				
Ilmenite, do	(b)	(b)		
Rutile, do	(d)	(d)		
Miscellaneous		2,488,573		3,084,441
Total value, eliminating duplications		10,513,495		22,923,780

[a] Exclusive of pottery, value for which is included under "Miscellaneous."
[b] Value included under "Miscellaneous."
[c] Value not included in total value for State.
[d] Information not available for publication by the Survey.

Mineral production of Georgia in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	(a)	(a)	(a)	(a)
Barytes.....do....	85,303	$667,521	84,644	$790,362
Bauxite.....long tons..	37,201	307,573	34,397	300,187
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	3,796,160	.....	5,572,999
Clay, raw.....short tons..	95,587	b 703,639	187,364	b 1,071,794
Coal.....do....	53,337	198,033	50,156	251,000
Coke.....do....	18,149	b 149,022	16,523	b 197,285
Copper.....pounds..	8,306	1,545	5,780	1,064
Fuller's earth.....short tons..	(a)	(a)	(a)	(a)
Gems and precious stones.....	.....	.....	.....	(a)
Gold.....troy ounces..	37	767	35	732
Iron ore:				
Sold to furnaces.....long tons..	74,007	294,619	104,482	460,633
Sold for paint.....do....	.....	.....	(a)	(a)
Lead.....short tons..	.....	.....	2	304
Lime.....do....	.....	.....	(a)	(a)
Manganese ore.....long tons..	48	(a)	341	9,512
Manganiferous ore.....do....	3,726	(a)	6,075	(a)
Mica:				
Scrap.....short tons..	51	778	101	3,015
Sheet.....pounds..	47,018	19,682	50,095	13,692
Mineral waters.....gallons sold..	364,310	39,282	343,888	31,868
Peat.....short tons..	.....	.....	(a)	(a)
Potash (K_2O).....do....	(a)	(a)	.....	.....
Pyrites.....long tons..	34,412	349,779	(a)	(a)
Sand and gravel.....short tons..	362,487	181,844	375,052	231,858
Sand-lime brick.....thousands..	(a)	(a)	3,523	55,528
Silver.....troy ounces..	8	9	194	211
Stone.....short tons..	380,020	2,741,616	508,370	3,651,415
Talc.....do....	(a)	(a)	(a)	(a)
Miscellaneous.....	.....	830,764	.....	804,315
Total value, eliminating duplications.....	.....	9,429,972	.....	12,178,695

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of Idaho in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	$283,492	.....	$306,652
Clay, raw.....short tons..	(a b)	(a b)	873	b 8,802
Coal.....do....	(a)	(a)	(a)	(a)
Copper.....pounds..	3,122,763	580,834	2,538,396	467,065
Diatomaceous earth.....short tons..	(a)	(a)	(a)	(a)
Gems and precious stones.....	.....	.....	.....	(a)
Gold.....troy ounces..	34,503	713,238	23,490	485,590
Iron ore.....long tons..	1,838	(a)	275	(a)
Lead.....short tons..	91,171	9,664,121	124,805	19,968,798
Lime.....do....	(a)	(a)	(a)	(a)
Mica:				
Scrap.....do....	.....	.....	(a)	(a)
Sheet.....pounds..	.....	.....	(a)	(a)
Phosphate rock.....long tons..	(a)	(a)	53,734	292,006
Salt.....short tons..	39	530	(a)	(a)
Sand and gravel.....do....	(a)	(a)	24,939	19,956
Sand-lime brick.....thousands..	(a)	(a)	.....	.....
Silver.....troy ounces..	5,579,056	6,248,543	7,326,794	7,986,205
Stone.....short tons..	112,510	248,789	254,490	616,066
Zinc.....do....	7,997	1,167,579	13,966	2,262,518
Miscellaneous.....	.....	141,524	.....	44,927
Total value, eliminating duplications.....	.....	19,044,567	.....	32,449,783

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of Illinois in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	93,788	$1,138,759	85,575	$1,521,318
Barytes.....do....	(a)	(a)	(a)	(a)
Cement.....barrels..	b 4,873,831	b 7,901,689	b 5,148,040	b 10,012,158
Clay products.....	.....	17,408,022	.....	26,138,419
Clay, raw.....short tons..	139,458	c 302,306	195,421	c 432,964
Coal.....do....	60,862,608	140,075,969	88,724,893	273,509,000
Coke.....do....	1,703,903	c 13,206,405	2,136,793	c 25,791,092
Ferroalloys.....long tons..	(a c)	(a c)	(a c)	(a c)
Fluorspar.....short tons..	92,729	2,430,361	120,299	3,096,767
Iron, pig.....long tons..	2,532,341	c 61,829,286	3,238,814	c 90,736,015
Lead.....short tons..	2,105	223,130	1,743	278,880
Lime.....do....	65,060	580,041	87,903	982,743
Mineral paints, zinc and lead pigments..do....	(a c)	(a c)	(a c)	(a c)
Mineral waters.....gallons sold..	364,934	21,151	301,953	17,211
Natural gas.....M cubic feet..	3,824,666	612,000	3,013,100	476,550
Natural-gas gasoline.....gallons..	6,059,828	1,115,083	6,054,916	1,307,980
Peat.....short tons..	(a)	(a)	(a)	(a)
Petroleum.....barrels..	11,960,000	29,720,000	10,774,000	39,583,000
Potash (K_2O).....short tons..	(a)	(a)	.....	.....
Pyrites.....long tons..	13,353	46,634	(a)	(a)
Sand and gravel.....short tons..	7,093,333	4,252,094	7,669,500	6,139,169
Sand and sandstone (finely ground).....do....	43,067	255,250	63,664	425,824
Silver.....troy ounces..	4,440	4,973	8,193	8,930
Stone.....short tons..	5,035,770	3,790,133	5,103,700	5,673,831
Sulphuric acid (60° Baumé) d.....do....	e 249,943	e 2,691,900	f 285,693	3,051,202
Tripoli.....do....	13,014	116,492	24,458	360,651
Zinc.....do....	6,788	991,048	4,720	764,640
Miscellaneous.....	.....	3,956,522	.....	3,288,128
Total value, eliminating duplications.....	.....	213,701,212	.....	373,926,090

a Value included under "Miscellaneous."
b Exclusive of natural cement, value for which is included under "Miscellaneous."
c Value not included in total value for State.
d From zinc smelting.
e According to Bureau of the Census. Value partly estimated by Geological Survey to cover acid consumed by producer as well as that sold.
f Includes several thousand tons of stronger acid not converted to 60° Baumé.

Mineral production of Indiana in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Cement.....barrels..	a 7,667,976	a $12,527,770	a 10,191,126	a $18,649,115
Clay products.....	.....	11,634,097	.....	15,494,795
Clay, raw.....short tons..	76,906	b 80,267	76,341	b 124,200
Coal.....do....	20,912,288	46,345,750	29,350,585	92,867,000
Coke.....do....	3,702,180	b 27,543,179	4,553,697	b 46,994,153
Iron, pig.....long tons..	2,287,068	b 51,474,116	2,418,048	b 61,852,856
Lime.....short tons..	107,460	902,469	134,672	1,348,819
Mineral paints, zinc and lead pigments..do....	(b c)	(b c)	.....	.....
Mineral waters.....gallons sold..	538,294	181,495	571,293	183,939
Natural gas.....M cubic feet..	1,406,949	534,600	d 1,400,000	d 532,000
Natural-gas gasoline.....gallons..	1,800	357	.....	.....
Oilstones.....short tons..	447	44,822	469	50,200
Peat.....do....	(c)	(c)	(c)	(c)
Petroleum.....barrels..	972,000	2,284,000	945,000	3,407,000
Potash (K_2O).....short tons..	(c)	(c)	.....	.....
Sand and gravel.....do....	6,187,741	2,680,968	5,271,026	2,846,861
Sand-lime brick.....thousands..	11,738	108,089	10,034	128,013
Stone.....short tons..	1,645,450	4,953,903	2,382,200	9,228,755
Sulphuric acid e.....do....	.....	.....	(c)	(c)
Miscellaneous.....	.....	143,017	.....	1,773,797
Total value, eliminating duplications.....	.....	82,270,784	.....	146,510,294

a Exclusive of natural cement, value for which in included under "Miscellaneous."
b Value not included in total value for State.
c Value included under "Miscellaneous."
d Figures preliminary.
e From zinc smelting.

Mineral production of Iowa in 1919 and 1920.

Product.		1919		1920	
		Quantity.	Value.	Quantity.	Value.
Cement	barrels	4,569,110	$7,798,347	4,421,783	$8,742,854
Clay products			[a] 8,107,601		[a] 10,439,957
Clay, raw	short tons	8,506	[b] 5,600	36,577	[b] 36,275
Coal	do	5,624,692	17,352,620	7,813,916	30,794,000
Ferroalloys	long tons	[b c]	[b c]	[b c]	[b c]
Gypsum	short tons	421,279	2,634,444	571,895	4,422,965
Lime	do	[c]	[c]	[c]	[c]
Mineral waters	gallons sold	39,661	5,703	38,877	3,419
Natural gas	M cubic feet	740	200	830	300
Potash (K_2O)	short tons	89	20,025		
Sand and gravel	do	2,093,471	1,383,764	2,467,644	1,993,441
Stone	do	513,030	508,606	612,150	749,692
Miscellaneous			540,173		638,997
Total value, eliminating duplications			37,882,183		57,250,480

[a] Exclusive of pottery, value for which is included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Value included under "Miscellaneous."

Mineral production of Kansas in 1919 and 1920.

Product.		1919		1920	
		Quantity.	Value.	Quantity.	Value.
Asphalt	short tons	[a]	[a]	[a]	[a]
Cement	barrels	[b] 3,023,901	[b] $5,467,284	[b] 4,158,399	[b] $8,649,157
Clay products			3,426,002		[c] 4,921,740
Coal	short tons	5,224,724	15,917,053	5,926,408	22,923,000
Gypsum	do	78,479	520,673	130,044	968,298
Lead	do	11,283	1,195,998	16,788	2,686,080
Lime	do	[a]	[a]	[a]	[a]
Mineral paints, zinc and lead pigments	do	[a d]	[a d]	[a d]	[a d]
Mineral waters	gallons sold	394,625	69,482	422,069	57,361
Natural gas	M cubic feet	14,771,733	3,397,500	[e] 12,000,000	[e] 2,760,000
Natural-gas gasoline	gallons	3,283,850	620,876	4,330,748	828,887
Petroleum	barrels	33,048,000	77,026,000	39,005,000	133,469,000
Pumice	short tons	[a]	[a]	[a]	[a]
Salt	do	773,576	4,497,247	783,655	3,839,409
Sand and gravel	do	954,121	507,642	1,275,309	905,936
Stone	do	680,400	860,851	699,190	1,013,891
Zinc	do	47,636	6,954,856	61,073	9,893,826
Miscellaneous			1,483,061		1,948,798
Total value, eliminating duplications			120,759,783		193,693,758

[a] Value included under "Miscellaneous."
[b] Exclusive of natural cement, value for which is included under "Miscellaneous."
[c] Exclusive of pottery, value for which is included under "Miscellaneous."
[d] Value not included in total value for State.
[e] Figures preliminary.

Mineral production of Kentucky in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	(a)	(a)	(a)	(a)
Barytes.....do....	5,435	$36,408	(a)	(a)
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	5,711,257	.....	$7,309,194
Clay, raw.....short tons..	52,690	b 223,550	93,491	b 469,302
Coal.....do....	30,036,061	73,891,049	35,690,762	146,576,000
Coke.....do....	691,969	b 3,901,481	739,577	b 5,576,205
Fluorspar.....do....	32,386	883,171	46,091	1,246,942
Iron, pig.....long tons..	149,951	b 4,508,129	230,316	b 7,306,711
Lead.....short tons..	86	9,116	122	19,520
Lime.....do....	988	9,275	1,757	18,063
Mineral waters.....gallons sold..	213,436	37,876	256,959	39,600
Natural gas.....M cubic feet..	2,057,003	699,400	2,000,000	690,000
Natural-gas gasoline.....gallons..	5,136,326	1,144,746	4,497,320	1,071,628
Oilstones.....short tons..	(a)	(a)	(a)	(a)
Petroleum.....barrels..	9,278,000	24,597,000	8,738,000	34,279,000
Phosphate rock.....long tons..	(a)	(a)	(a)	(a)
Sand and gravel.....short tons..	1,151,297	744,073	1,637,618	1,047,770
Stone.....do....	1,215,330	1,447,352	1,422,530	1,756,176
Zinc.....do....	36	5,256	9	1,458
Miscellaneous.....	.....	1,089,861	.....	1,490,685
Total value, eliminating duplications....	.....	110,305,840	.....	195,546,036

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of Louisiana in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	(a)	(a)	.....	.....
Clay products.....	.....	b $759,386	.....	b $955,608
Mineral waters.....gallons sold..	(a)	(a)	(a)	(a)
Natural gas.....M cubic feet..	47,061,891	2,823,700	c 60,000,000	c 4,200,000
Natural-gas gasoline.....gallons..	10,063,025	1,667,275	10,609,629	1,712,613
Petroleum.....barrels..	17,188,000	26,803,000	35,714,000	112,606,000
Salt.....short tons..	(a)	(a)	265,085	1,517,414
Sand and gravel.....do....	772,943	605,401	1,072,468	791,147
Sand-lime brick.....thousands..	(a)	(a)	(a)	(a)
Stone.....short tons..	(a)	(a)	(a)	(a)
Sulphur.....long tons..	(a)	(a)	(a)	(a)
Miscellaneous.....	.....	6,192,747	.....	15,394,943
Total value, eliminating duplications.....	.....	38,851,509	.....	137,177,725

a Value included under "Miscellaneous."
b Exclusive of pottery, value for which is included under "Miscellaneous."
c Figures preliminary.

Mineral production of Maine in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	$612,562	.....	$838,258
Copper.....pounds..	376,186	69,971	.....	.....
Feldspar.....short tons..	14,387	206,659	50,794	615,654
Ferroalloys.....long tons..	.....	.....	(a b)	(a b)
Gems and precious stones.....	.....	16,225	.....	3,738
Gold.....troy ounces..	7	145	.....	.....
Lead.....short tons..	1	106	.....	.....
Lime.....do....	96,582	1,207,508	101,503	1,495,625
Magnesium.....pounds..	(c)	(c)	.....	.....
Mineral waters.....gallons sold..	728,606	309,460	732,810	301,851
Sand and gravel.....short tons..	46,296	39,319	76,493	82,237
Silica (quartz).....do....	(a)	(a)	(a)	(a)
Silver.....troy ounces..	4,142	4,639	.....	.....
Slate.....	.....	279,274	.....	450,561
Stone.....short tons..	173,050	1,327,330	192,440	1,924,990
Miscellaneous.....	.....	672	.....	178,500
Total value, eliminating duplications.....	.....	4,073,870	.....	5,714,114

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Included in New York figures. Not separable.

Mineral production of Maryland in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	(a)	(a)	(a)	(a)
Cement.....barrels..	(a)	(a)	(a)	(a)
Chromite.....long tons..	69	$3,467		
Clay products.....		2,734,141		$3,973,178
Clay, raw.....short tons..	20,650	b 57,516	27,772	b 116,280
Coal.....do....	3,021,686	8,255,984	4,065,239	18,815,000
Coke.....do....	356,237	(a b)	682,132	(a b)
Diatomaceous earth.....do....			(a)	(a)
Feldspar.....do....	7,820	39,610	20,159	312,292
Ferroalloys.....long tons..	(a b)	(a b)	(a b)	(a b)
Iron ore:				
Sold to furnaces.....do....	1,501	(a)	1,360	(a)
Sold for paint.....do....	(a)	(a)	(a)	(a)
Iron, pig.....do....	(a b)	(a b)	(a b)	(a b)
Lime.....short tons..	103,563	860,187	100,914	951,588
Millstones.....				(a)
Mineral paints, zinc and lead pigments .....short tons..	(a b)	(a b)	(a b)	(a b)
Mineral waters.....gallons sold..	1,077,253	105,397	986,379	95,565
Natural gas.....M cubic feet..	167	60	170	50
Potash (K_2O).....short tons..	(a)	(a)	1,447	313,505
Sand and gravel.....do....	1,747,587	1,800,882	1,543,791	1,627,889
Silica (quartz).....do....	7,909	88,713	2,261	30,588
Slate.....		71,593		80,789
Stone.....short tons..	871,750	1,331,710	c 811,500	c 1,273,741
Talc.....do....	(a)	(a)	4,372	17,948
Miscellaneous.....		11,958,766		30,193,316
Total value, eliminating duplications.....		18,345,024		31,155,798

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Exclusive of marble, value for which is included under "Miscellaneous."

Mineral production of Massachusetts in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products.....		$2,254,150		$3,498,378
Clay, raw.....short tons..	(a b)	(a b)	(a b)	(a b)
Coke.....do....	393,331	(a b)	488,089	(a b)
Fuller's earth.....do....	(a)	(a)	(a)	(a)
Gold.....troy ounces..			9	178
Iron ore.....long tons..	6,852	(a)	8,537	(a)
Iron, pig.....do....	(a b)	(a b)	3,906	(a b)
Lead.....short tons..			14	2,206
Lime.....do....	131,762	1,339,464	129,108	1,753,110
Mineral waters.....gallons sold..	1,630,216	112,213	1,277,708	105,008
Peat.....short tons..	(a)	(a)	(a)	(a)
Potash (K_2O).....do....	1	453		
Sand and gravel.....do....	1,381,555	1,839,435	1,246,956	1,400,335
Sand-lime brick.....thousands..	(a)	(a)	(a)	(a)
Silica (quartz).....short tons..	(a)	(a)	(a)	(a)
Silver.....troy ounces..			1,160	1,264
Stone.....short tons..	1,370,830	4,363,813	1,294,770	5,397,782
Talc.....do....	(a)	(a)	(a)	(a)
Miscellaneous.....		3,443,998		7,506,202
Total value, eliminating duplications.....		10,070,543		12,411,708

a Value included under "Miscellaneous."
b Value not included in total value for State.

Mineral production of Michigan in 1919 and 1920.

Product.		1919		1920	
		Quantity.	Value.	Quantity.	Value.
Bromine	pounds	1,736,633	$1,179,834	1,046,165	$692,100
Calcium chloride	short tons	21,668	256,091	19,182	398,633
Cement	barrels	4,990,308	8,468,196	4,442,455	10,939,633
Clay products			5,796,803		6,572,316
Clay, raw	short tons	568	[a] 2,123	5,066	[a] 11,295
Coal	do	996,545	3,864,228	1,489,765	7,346,000
Coke	do	808,729	[a] 6,204,747	1,393,445	[a] 15,731,994
Copper	pounds	178,826,486	33,261,726	154,695,073	28,463,893
Gems and precious stones			277		[b]
Grindstones	short tons	[b]	[b]	[b]	[b]
Gypsum	do	339,125	2,390,367	382,212	3,521,028
Iron ore:					
Sold to furnaces	long tons	12,911,727	49,774,212	18,862,578	85,749,217
Sold for paint	do	481	[b]	1,863	[b]
Iron, pig	do	416,277	[a] 13,418,185	464,197	[a] 16,812,062
Lime	short tons	145,783	1,381,534	140,813	1,386,760
Magnesium	pounds	[b]	[b]	[b]	[b]
Manganiferous ore	long tons	29,296	[b]	53,373	[b]
Mineral waters	gallons sold	1,570,906	132,312	1,227,485	122,010
Natural gas	M cubic feet	1,098	800	440	350
Peat	short tons			[b]	[b]
Petroleum	barrels	[b]	[b]		
Potash (K_2O)	short tons	149	48,581	49	18,312
Salt	do	2,492,378	9,456,138	2,262,915	10,698,674
Sand and gravel	do	3,772,535	1,944,143	4,386,582	2,867,466
Sand-lime brick	thousands	42,063	507,010	39,280	640,744
Silica (quartz)	short tons	[b]	[b]	[b]	[b]
Silver	troy ounces	441,430	494,402	470,189	512,506
Stone	short tons	7,222,200	3,859,930	9,812,780	6,054,276
Miscellaneous			157,190		354,950
Total value, eliminating duplications			122,973,774		166,338,868

[a] Value not included in total value for State. [b] Value included under "Miscellaneous."

Mineral production of Minnesota in 1919 and 1920.

Product.		1919		1920	
		Quantity.	Value.	Quantity.	Value.
Cement	barrels	1,632,374	$2,489,518	1,784,152	$2,975,915
Clay products			[a] 2,287,906		[a] 3,341,477
Clay, raw	short tons	22,907	[b] 35,827	[b c]	[b c]
Coke	do	586,094	[b] 3,969,068	674,801	[b] 10,675,352
Flint lining for tube mills	do	[c]	[c]	[c]	[c]
Gems and precious stones					67
Iron ore	long tons	34,547,356	121,107,247	39,747,594	163,538,054
Iron, pig	do	[b c]	[b c]	340,190	[b c]
Lime	short tons	23,005	294,313	30,120	356,906
Manganiferous ore	long tons	245,883	885,996	542,437	1,611,946
Mineral waters	gallons sold	2,731,967	113,776	2,357,991	136,632
Peat	short tons			[c]	[c]
Pebbles for grinding	do	[c]	[c]	[c]	[c]
Sand and gravel	do	1,304,395	905,341	1,806,368	1,331,515
Sand-lime brick	thousands	23,391	239,676	24,891	290,394
Stone	short tons	462,040	2,345,162	685,810	3,149,751
Miscellaneous			8,694,172		10,445,517
Total value, eliminating duplications			131,529,797		177,589,967

[a] Exclusive of pottery, value for which is included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Value included under "Miscellaneous."

Mineral production of Mississippi in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products		$951,161		$1,075,752
Clay, raw, short tons	2,560	[a] 10,780	[a b]	[a b]
Mineral waters, gallons sold	124,788	29,126	136,175	31,312
Sand and gravel, short tons	1,624,538	645,795	1,770,981	1,090,949
Stone, do	[b]	[b]	[b]	[b]
Miscellaneous		1,949		21,573
Total value, eliminating duplications		1,628,031		2,201,246

[a] Value not included in total value for State. [b] Value included under "Miscellaneous."

Mineral production of Missouri in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Barytes, short tons	73,247	$640,398	99,654	$1,013,570
Briquets, fuel, do	[a b]	[a b]	[a b]	[a b]
Cement, barrels	5,496,164	9,264,017	5,605,952	10,980,453
Chats, short tons	1,375,757	[c] 550,300	1,113,522	[c] 501,000
Clay products		10,997,949		17,474,542
Clay, raw, short tons	341,385	[b] 1,004,033	448,984	[b] 1,413,189
Coal, do	3,979,798	12,766,366	5,369,565	22,230,000
Cobalt, do	28	122,452	51	262,801
Coke, do	[a b]	[a b]	[a b]	[a b]
Copper, pounds	1,617,200	300,799	1,512,539	278,307
Iron ore, long tons	53,626	223,144	50,825	230,827
Iron, pig, do	49,383	[b] 1,649,271	81,682	[b] 3,678,623
Lead, short tons	163,290	17,308,740	165,114	26,418,240
Lime, do	180,749	1,735,705	209,113	2,319,285
Mineral paints, zinc and lead pigments, do	[a b]	[a b]	[a b]	[a b]
Mineral waters, gallons sold	212,871	39,641	323,628	50,892
Natural gas, M cubic feet	4,606	3,000	[d] 3,730	[d] 2,200
Nickel, short tons	130	85,118	138	103,361
Petroleum, barrels	[a]	[a]	[a]	[a]
Potash (K_2O), short tons	[a]	[a]	6	1,081
Pyrites, long tons	[a]	[a]	[a]	[a]
Sand and gravel, short tons	1,665,295	873,333	1,909,314	1,356,352
Silver, troy ounces	90,401	101,249	111,128	121,130
Stone, short tons	1,146,040	2,190,884	1,457,960	3,518,387
Tripoli, do	2,950	8,926	[e]	[e]
Zinc, do	31,540	4,604,840	24,509	3,970,458
Miscellaneous		2,988,345		4,561,055
Total value, eliminating duplications		61,862,232		90,993,679

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Value estimated.
[d] Figures preliminary.
[e] Includes production from Oklahoma. Not separable. Value included under "Miscellaneous."

Mineral production of Montana in 1919 and 1920.

Product.		1919		1920	
		Quantity.	Value.	Quantity.	Value.
Cement	barrels	(a)	(a)	(a)	(a)
Clay products			$394,899		$407,984
Clay, raw	short tons	5,077	b 30,551	2,582	b 15,614
Coal	do	3,236,369	8,644,344	4,413,866	13,923,000
Copper	pounds	169,981,288	31,616,520	177,059,260	32,578,904
Ferroalloys	long tons	(a b)	(a b)	(a b)	(a b)
Gems and precious stones			48,391		223,196
Gold	troy ounces	107,856	2,229,588	89,550	1,851,165
Graphite, crystalline	pounds			(a)	(a)
Gypsum	short tons	(a)	(a)	(a)	(a)
Iron ore	long tons	3,438	(a)	10,803	73,889
Lead	short tons	17,219	1,825,201	15,627	2,500,313
Lime	do	3,340	35,834	2,638	30,020
Manganese ore	long tons	24,993	993,633	76,441	1,966,881
Mineral waters	gallons sold	499,225	6,811	(a)	(a)
Natural gas	M cubic feet	857,958	85,800	817,730	88,100
Petroleum	barrels	90,000	171,000	340,000	1,045,000
Sand and gravel	short tons	159,564	71,736	248,260	73,986
Silica (quartz)	do	(a)	(a)		
Silver	troy ounces	12,541,181	14,046,123	12,579,178	13,711,304
Stone	short tons	209,140	183,703	275,150	296,019
Sulphuric acid c	do			(a)	(a)
Zinc	do	84,382	12,319,759	92,169	14,931,361
Miscellaneous			1,030,066		3,435,685
Total value, eliminating duplications			73,630,824		85,885,503

a Value included under "Miscellaneous."
b Value not included in total value for State.
c From copper smelting.

Mineral production of Nebraska in 1919 and 1920.

Product.		1919		1920	
		Quantity.	Value.	Quantity.	Value.
Cement	barrels	(a)	(a)	(a)	(a)
Clay products			b $1,038,668		b $1,211,868
Clay, raw	short tons	(a c)	(a c)	(a c)	(a c)
Gems and precious stones					(a)
Mineral paints, zinc and lead pigments	short tons	(a c)	(a c)	(a c)	(a c)
Mineral waters	gallons sold	(a)	(a)		
Potash (K_2O)	short tons	24,557	5,449,275	20,397	3,919,534
Pumice	do	(a)	(a)	(a)	(a)
Sand and gravel	do	1,211,395	556,080	1,676,440	746,726
Stone	do	203,550	280,662	220,530	453,179
Miscellaneous			344,337		852,661
Total value, eliminating duplications			7,658,424		7,168,424

a Value included under "Miscellaneous."
b Exclusive of pottery, value for which is included under "Miscellaneous."
c Value not included in total value for State.

Mineral production of Nevada in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons..	(a)	(a)	(a)	(a)
Clay products.....	.....	(a)	.....	(a)
Clay, raw.....short tons..	(a b)	(a b)	(a b)	(a b)
Copper.....pounds..	52,331,175	$9,733,599	50,559,763	$9,302,996
Diatomaceous earth.....short tons..	(a)	(a)	(a)	(a)
Fluorspar.....do....	(a)	(a)	532	(a)
Fuller's earth.....do....	.....	.....	(a)	(a)
Gems and precious stones.....	.....	13,679	.....	12,920
Gold.....troy ounces..	219,695	4,541,502	172,540	3,566,728
Graphite, amorphous.....short tons..	(a)	(a)	(a)	(a)
Gypsum.....do....	91,756	497,561	143,929	1,100,261
Iron ore:				
Sold to furnaces.....long tons..	.....	.....	138	(a)
Sold for paint.....do....	.....	.....	100	(a)
Lead.....short tons..	7,675	813,517	10,632	1,701,096
Lime.....do....	(a)	(a)	(a)	(a)
Manganese ore.....long tons..	425	(a)	1,240	21,673
Manganiferous ore.....do....	85,110	200,799	95,142	286,440
Mineral waters.....gallons sold..	(a)	(a)	(a)	(a)
Pebbles for grinding.....short tons..	(a)	(a)	(a)	(a)
Platinum and allied metals.....troy ounces..	(a)	(a)	.....	.....
Quicksilver.....flasks..	756	68,259	83	6,612
Salt.....short tons..	(a)	(a)	(a)	(a)
Sand and gravel.....do....	70,569	7,011	7,640	2,797
Silica (quartz).....do....	.....	.....	(a)	(a)
Silver.....troy ounces..	6,863,580	7,687,210	7,745,093	8,442,151
Stone.....short tons..	53,720	88,566	(a)	(a)
Sulphur.....long tons..	(a)	(a)	(a)	(a)
Zinc.....short tons..	4,502	657,343	5,349	866,541
Miscellaneous.....	.....	149,235	.....	339,946
Total value, eliminating duplications.....	.....	24,457,735	.....	25,648,961

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of New Hampshire in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	a $608,155	.....	$650,697
Fluorspar.....short tons..	(b)	(b)	202	(b)
Garnet, abrasive.....do....	(b)	(b)	(b)	(b)
Gems and precious stones.....	.....	(b)	.....	(b)
Mica:				
Scrap.....short tons..	738	13,356	435	12,877
Sheet.....pounds..	235,724	90,915	284,862	83,811
Mineral waters.....gallons sold..	197,012	8,941	(b)	(b)
Peat.....short tons..	(b)	(b)	(b)	(b)
Sand and gravel.....do....	333,073	70,174	314,932	107,461
Scythestones.....do....	(b)	(b)	(b)	(b)
Stone.....do....	104,690	1,443,204	122,980	2,033,113
Miscellaneous.....	.....	60,214	.....	98,526
Total value, eliminating duplications.....	.....	2,294,959	.....	2,986,485

a Exclusive of pottery, value for which is included under "Miscellaneous."
b Value included under "Miscellaneous."

Mineral production of New Jersey in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Briquets, fuel.....short tons..	(a b)	(a b)	(a b)	(a b)
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	$26,545,959	.....	$40,021,028
Clay, raw.....short tons..	278,190	b 1,078,482	354,613	b 1,656,867
Coke.....do....	788,465	(a b)	725,571	(a b)
Ferroalloys.....long tons..	(a b)	(a b)	(a b)	(a b)
Gems and precious stones.....	.....	.....	.....	(a)
Iron ore:				
Sold to furnaces.....long tons..	336,629	1,712,255	417,100	2,595,949
Sold for paint.....do....	.....	.....	(a)	(a)
Iron, pig.....do....	111,362	b 3,505,635	88,408	b 3,380,145
Lime.....short tons..	4,828	29,098	3,301	27,407
Manganiferous residuum c.....long tons..	80,418	(a)	133,602	(a)
Marl, greensand.....short tons..	(a)	(a)	(a)	(a)
Mineral paints, zinc and lead pigments.....short tons..	(a b)	(a b)	(a b)	(a b)
Mineral waters.....gallons sold..	1,244,983	143,303	702,867	68,036
Peat.....short tons..	27,743	267,567	26,623	281,527
Sand and gravel.....do....	3,710,226	2,576,272	4,616,444	4,330,844
Sand and sandstone (finely ground).....do....	.....	.....	(a)	(a)
Stone.....do....	1,625,870	2,521,860	1,679,720	2,777,018
Sulphuic acid d.....do....	(a)	(a)	.....	.....
Talc.....do....	.....	.....	(a)	(a)
Zinc.....do....	92,912	(a)	77,371	(a)
Miscellaneous.....	.....	28,798,876	.....	30,294,446
Total value, eliminating duplications.....	.....	56,898,033	.....	72,335,207

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Ore mined in New Jersey; smelted in Pennsylvania.
d From copper smelting. Figures according to Bureau of the Census.

Mineral production of New Mexico in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	$235,118	.....	$373,600
Clay, raw.....short tons..	1,609	a 7,504	1,916	a 7,119
Coal.....do....	3,138,756	9,750,833	3,683,440	13,568,000
Coke.....do....	260,162	a 1,777,769	(a b)	(a b)
Copper.....pounds..	51,150,541	9,514,000	54,400,691	10,009,727
Fluorspar.....short tons..	2,346	37,643	6,353	101,460
Gems and precious stones.....	.....	(b)	.....	1,315
Gold.....troy ounces..	31,717	655,656	23,235	480,302
Gypsum.....short tons..	(b)	(b)	(b)	(b)
Iron ore.....long tons..	224,553	506,538	274,705	547,370
Lead.....short tons..	1,443	152,985	1,435	229,562
Lime.....do....	1,758	17,615	3,034	34,680
Manganese ore.....long tons..	.....	.....	2,053	32,107
Manganiferous ore.....do....	16,520	75,367	19,800	98,343
Mica:				
Scrap.....short tons..	(b)	(b)	(b)	(b)
Sheet.....pounds..	(b)	(b)	.....	.....
Mineral paints, zinc and lead pigments.....short tons..	(a b)	(a b)	(a b)	(a b)
Mineral waters.....gallons sold..	(b)	(b)	(b)	(b)
Molybdenum.....pounds..	1,113	1,370	34,900	17,207
Petroleum.....barrels..	(b)	(b)	(b)	(b)
Salt.....short tons..	(b)	(b)	(b)	(b)
Sand and gravel.....do....	(b)	(b)	209,193	128,815
Silver.....troy ounces..	837,418	937,908	768,042	837,166
Stone.....short tons..	52,990	56,373	331,690	297,271
Zinc.....do....	3,797	554,409	5,007	811,100
Miscellaneous.....	.....	229,145	.....	2,549,910
Total value, eliminating duplications.....	.....	22,679,960	.....	27,883,565

a Value not included in total value for State. b Value included under "Miscellaneous."

Mineral production of New York in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Aluminum.....pounds..	(a b)	(a b)	(a b)	(a b)
Briquets, fuel.....short tons..			(a b)	(a b)
Cement.....barrels..	4,441,250	$7,700,406	c 6,049,150	c $12,206,698
Clay products.....		14,468,586		19,113,684
Clay, raw.....short tons..	(a b)	(a b)	8,545	b 43,672
Coke.....do....	751,067	b 5,754,699	1,040,192	b 12,066,227
Diatomaceous earth.....do....	(a)	(a)	(a)	(a)
Emery.....do....	1,563	13,459	1,596	14,375
Feldspar.....do....	(a)	(a)	21,609	163,215
Ferroalloys.....long tons..	38,295	b 8,014,949	73,887	b 9,851,373
Garnet, abrasive.....short tons..	4,623	301,252	4,276	359,425
Gems and precious stones.....				(a)
Graphite:				
Artificial.....pounds..	8,163,177	(a b)	7,399,749	(a b)
Crystalline.....do....	(a)	(a)	(a)	(a)
Gypsum.....short tons..	591,153	3,530,743	780,295	6,438,929
Iron ore:				
Sold to furnaces.....long tons..	701,688	4,002,312	959,408	6,263,252
Sold for paint.....do....	8,638	(a)	13,501	(a)
Iron, pig.....do....	1,854,594	b 49,784,659	2,415,627	b 89,416,703
Lime.....short tons..	126,404	1,131,860	92,357	1,047,261
Magnesium.....pounds..	(a b d)	(a b d)	(a b)	(a b)
Marl, calcareous.....short tons..			10,950	7,834
Millstones.....		10,155		13,331
Mineral waters.....gallons sold..	6,537,966	815,615	5,242,047	671,066
Natural gas.....M cubic feet..	8,123,889	2,843,400	e 8,000,000	e 2,800,000
Natural-gas gasoline.....gallons..	457,985	84,083	411,078	75,576
Peat.....short tons..	177	1,322	(a)	(a)
Petroleum.....barrels..	851,000	3,100,000	906,000	5,433,000
Potash (K_2O).....short tons..	(a)	(a)	(a)	(a)
Pyrites.....long tons..	60,544	468,257	30,753	261,575
Salt.....short tons..	1,947,829	7,159,547	1,903,101	7,584,921
Sand and gravel.....do....	3,987,987	2,246,880	6,127,018	4,338,457
Sand-lime brick.....thousands..	10,958	159,399	11,294	176,114
Silica (quartz).....short tons..	(a)	(a)	(a)	(a)
Slate.....		450,379		911,293
Stone.....short tons..	4,093,210	5,856,875	5,969,730	8,014,446
Talc.....do....	62,495	750,765	68,168	977,228
Zinc.....do....	5,120	747,666	5,654	915,948
Miscellaneous.....		25,905,752		25,085,648
Total value, eliminating duplications.....		56,379,564		78,078,505

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Exclusive of natural cement, value for which is included under "Miscellaneous."
d Includes production from Maine. Not separable.
e Figures preliminary.

Mineral production of North Carolina in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Aluminum.....pounds..	(a b)	(a b)	(a b)	(a b)
Asbestos.....short tons..	(a)	(a)	.....	.....
Barytes.....do....	(a)	(a)	(a)	(a)
Clay products.....	.....	$3,477,489	.....	$3,884,988
Clay, raw.....short tons..	(a b)	(a b)	13,970	b 244,695
Coal.....do....	6,989	26,871	11,540	81,000
Copper.....pounds..	3,704	620	.....	.....
Feldspar.....short tons..	25,195	116,820	91,000	187,190
Garnet, abrasive.....do....	(a)	(a)	.....	.....
Gems and precious stones.....	.....	.....	.....	(a)
Gold.....troy ounces..	1	20	57	1,147
Iron ore.....long tons..	58,778	231,530	71,810	200,382
Lime.....short tons..	(a)	(a)	(a)	(a)
Manganiferous ore.....long tons..	30	(a)	.....	.....
Marl, calcareous.....short tons..	20,000	80,000	13,000	52,000
Mica:				
Scrap.....do....	1,509	32,358	2,828	91,653
Sheet.....pounds..	1,021,309	331,428	1,084,946	405,654
Millstones.....	.....	29,025	.....	14,226
Mineral waters.....gallons sold..	62,925	10,886	115,918	15,545
Peat.....short tons..	(a)	(a)	(a)	(a)
Sand and gravel.....do....	600,887	266,631	520,125	402,748
Silica (quartz).....do....	(a)	(a)	(a)	(a)
Silver.....troy ounces..	19	21	10	11
Stone.....short tons..	629,559	1,681,203	c 972,810	c 2,088,266
Talc.....do....	2,602	76,158	2,307	76,474
Miscellaneous.....	.....	5,302,911	.....	10,510,091
Total value, eliminating duplications.....	.....	9,229,959	.....	7,760,482

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Exclusive of marble, value for which is included under "Miscellaneous."

Mineral production of North Dakota in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Briquets, fuel.....short tons..	(a b)	(a b)	(a b)	(a b)
Clay products.....	.....	$330,657	.....	$350,548
Clay, raw.....short tons..	.....	.....	(a b)	(a b)
Coal.....do....	840,959	2,100,303	948,625	2,724,000
Mineral waters.....gallons sold..	110,000	1,100	(a)	(a)
Natural gas.....M cubic feet..	2,221	800	1,000	400
Sand and gravel.....short tons..	(a)	(a)	(a)	(a)
Sand-lime brick.....thousands..	(a)	(a)	30	500
Miscellaneous.....	.....	8,915	.....	13,146
Total value, eliminating duplications.....	.....	2,413,029	.....	3,078,648

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of Ohio in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	(a)	(a)		
Bromine.....pounds..	(a)	(a)	(a)	(a)
Calcium chloride.....short tons..	(a)	(a)	(a)	(a)
Cement.....barrels..	b 1,821,597	b $3,311,179	b 1,670,958	b $3,561,490
Clay products.....		63,787,319		82,061,960
Clay, raw.....short tons..	212,534	c 464,901	311,806	c 729,617
Coal.....do....	35,876,682	79,496,301	45,878,191	175,081,000
Coke.....do....	5,481,660	c 30,703,614	5,701,810	c 53,242,020
Ferroalloys.....long tons..	53,109	c 2,292,888	79,208	c 3,963,635
Grindstones and pulpstones.....short tons..	39,835	1,060,875	42,385	1,310,445
Gypsum.....do....	251,259	2,049,723	277,899	2,161,038
Iron, pig.....long tons..	6,994,999	c 178,999,271	8,229,770	c 246,326,276
Lime.....short tons..	512,614	4,477,987	558,892	6,238,908
Marl, calcareous.....do....			410	1,743
Mineral waters.....gallons sold..	2,341,853	142,970	2,337,437	169,400
Natural gas.....M cubic feet..	61,964,488	19,828,600	d 62,500,000	d 20,000,000
Natural-gas gasoline.....gallons..	8,800,961	1,963,763	10,015,638	2,194,558
Oilstones and scythestones.....short tons..	212	19,739	213	26,785
Petroleum.....barrels..	7,736,000	23,333,000	7,400,000	37,338,000
Potash (K_2O).....short tons..	55	13,079	31	6,515
Pyrites.....long tons..	4,609	16,886		
Salt.....short tons..	991,730	2,362,941	1,057,802	3,324,492
Sand and gravel.....do....	6,439,979	4,601,392	6,665,819	6,434,627
Sand-lime brick.....thousands..	(a)	(a)	8,350	120,075
Stone.....short tons..	8,011,530	8,009,649	9,105,630	10,856,468
Sulphuric acid e.....do....	(a)	(a)	(a)	(a)
Miscellaneous.....		354,485		3,369,995
Total value, eliminating duplications.....		214,829,888		354,257,499

a Value included under "Miscellaneous."
b Exclusive of natural cement, value for which is included under "Miscellaneous."
c Value not included in total value for State.
d Figures preliminary.
e From zinc smelting. Figures for 1919 according to Bureau of the Census.

Mineral production of Oklahoma in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	178,711	$1,857,513	152,087	$1,758,701
Cement.....barrels..	1,366,884	2,657,339	1,484,698	3,284,412
Clay products.....		2,190,129		2,769,013
Coal.....short tons..	3,802,113	14,544,901	4,849,288	23,294,000
Coke.....do....	(a b)	(a b)		
Gypsum.....do....	114,313	708,660	135,279	816,768
Lead.....do....	53,872	5,710,432	65,394	10,463,040
Lime.....do....	(a)	(a)	(a)	(a)
Mineral paints, zinc and lead pigments...do....	(a b)	(a b)	(a b)	(a b)
Mineral waters.....gallons sold..	1,368,375	41,825	1,437,810	49,287
Natural gas.....M cubic feet..	163,148,647	19,577,800	c 180,000,000	c 22,600,000
Natural-gas gasoline.....gallons..	189,995,038	32,564,532	178,856,929	31,334,493
Petroleum.....barrels..	86,911,000	184,100,000	106,206,000	356,439,000
Sand and gravel.....short tons..	467,482	304,029	875,677	626,099
Stone.....do....	664,710	726,059	875,560	1,056,136
Tripoli.....do....	(a)	(a)	(d)	(d)
Zinc.....do....	178,410	26,047,860	219,727	35,595,774
Miscellaneous.....		656,989		571,929
Total value, eliminating duplications.....		291,078,174		490,115,359

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures preliminary.
d Included in Missouri figures. Not separable.

Mineral production of Oregon in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Briquets, fuel.....short tons..	(a b)	(a b)	(a b)	(a b)
Cement.....barrels..	(a)	(a)	(a)	(a)
Chromite.....long tons..	538	$9,752	955	$7,486
Clay products.....	.....	c 378,963	.....	c 719,486
Clay, raw.....short tons..	(a b)	(a b)	(a b)	(a b)
Coal.....do....	18,739	63,794	20,717	93,000
Copper.....pounds..	2,214,815	411,955	2,355,276	433,371
Diatomaceous earth.....short tons..	(a)	(a)	.....	.....
Ferroalloys.....long tons..	(a b)	(a b)	.....	.....
Gems and precious stones.....	.....	3,025	.....	2,475
Gold.....troy ounces..	47,303	977,845	49,221	1,017,490
Gypsum.....short tons..	(a)	(a)	(a)	(a)
Lime.....do....	(a)	(a)	(a)	(a)
Mineral waters.....gallons sold..	2,600	1,140	2,360	701
Natural gas.....M cubic feet..	200	100	200	100
Platinum and allied metals.....troy ounces..	86	12,567	11	2,101
Quicksilver.....flasks..	435	39,276	24	1,912
Sand and gravel.....short tons..	797,288	506,526	1,245,502	1,028,253
Silver.....troy ounces..	111,121	124,455	82,743	90,190
Stone.....short tons..	523,040	728,863	805,950	1,030,220
Miscellaneous.....	.....	1,058,272	.....	1,619,686
Total value, eliminating duplications.....	.....	3,962,822	.....	5,496,253

a Value included under "Miscellaneous." b Value not included in total value for State.
c Exclusive of pottery, value for which is included under "Miscellaneous."

Mineral production of Pennsylvania in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Briquets, fuel.....short tons..	39,173	a $161,958	182,389	a $1,021,372
Cement.....barrels..	b 26,250,077	b 43,126,528	b 27,662,116	b 52,632,082
Clay products.....	.....	39,270,613	.....	50,983,988
Clay, raw.....short tons..	415,097	a 1,349,466	603,000	a 2,332,225
Coal:				
Anthracite.....do....	88,092,201	364,926,950	89,598,249	434,252,198
Bituminous.....do....	150,758,154	365,430,504	170,153,847	639,838,000
Coke.....do....	20,501,831	a 102,902,920	23,638,739	a 217,666,031
Copper.....pounds..	.....	.....	405,092	74,537
Feldspar.....short tons..	(c)	(c)	8,562	81,104
Ferroalloys.....long tons..	218,259	a 31,067,123	340,743	a 50,169,570
Gems and precious stones.....	.....	.....	.....	(c)
Graphite, crystalline.....pounds..	484,060	26,003	(c)	(c)
Iron ore:				
Sold to furnaces.....long tons..	616,271	1,340,219	719,813	1,406,929
Sold for paint.....do....	4,183	36,130	(c)	(c)
Iron, pig.....do....	11,901,992	a 307,824,587	13,472,814	a 448,251,415
Lead.....short tons..	.....	.....	7	1,176
Lime.....do....	779,608	6,181,710	784,083	7,519,147
Marl, calcareous.....do....	1,500	9,750	.....	.....
Millstones.....	.....	(c)	.....	.....
Mineral paints, zinc and lead pigments.....short tons..	(a c)	(a c)	(a c)	(a c)
Mineral waters.....gallons sold..	872,595	83,583	641,440	66,945
Natural gas.....M cubic feet..	113,527,916	31,787,800	d 112,000,000	d 31,500,000
Natural-gas gasoline.....gallons..	20,283,336	4,407,318	21,151,135	4,382,380
Pebbles for grinding.....short tons..	.....	.....	(c)	(c)
Petroleum.....barrels..	8,137,000	33,688,000	7,438,000	44,464,000
Potash (K_2O).....short tons..	330	93,134	109	16,823
Pyrites.....long tons..	(c)	(c)	(c)	(c)
Sand and gravel.....short tons..	5,699,306	5,892,679	6,421,739	8,347,271
Sand and sandstone (finely ground).....do....	.....	.....	(c)	(c)
Sand-lime brick.....thousands..	(c)	(c)	10,840	154,983
Silica (quartz).....short tons..	(c)	(c)	(c)	(c)
Silver.....troy ounces..	.....	.....	90	98
Slate.....	.....	2,885,072	.....	3,850,267
Stone.....short tons..	13,262,310	16,529,971	e 14,296,630	e 20,615,316
Sulphuric acid (60° Baumé)f.....do....	(c)	(c)	g 101,755	1,599,917
Talc.....do....	(c)	(c)	(c)	(c)
Tripoli (rottenstone).....do....	(c)	(c)	(c)	(c)
Miscellaneous.....	.....	22,546,557	.....	17,459,857
Total value, eliminating duplications.....	.....	918,048,917	.....	1,302,352,040

a Value not included in total value for State.
b Exclusive of natural cement, value for which is included under "Miscellaneous."
c Value included under "Miscellaneous." d Figures preliminary.
e Exclusive of marble, value for which is included under "Miscellaneous."
f From zinc smelting. Figures for 1919 according to Bureau of the Census.
g Includes several thousand tons of stronger acid not converted to 60° Baumé.

Mineral production of Rhode Island in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products		(a)		(a)
Coke.....short tons	(a b)	(a b)	(a b)	(a b)
Graphite, amorphous.....do	(a)	(a)	(a)	(a)
Lime.....do	(a)	(a)	(a)	(a)
Mineral waters.....gallons sold	317,571	$26,039	370,315	$21,946
Sand and gravel.....short tons	8,950	11,142	17,979	29,542
Stone.....do	117,700	635,112	c 123,470	c 786,815
Miscellaneous		1,028,690		1,820,442
Total value, eliminating duplications		853,981		1,175,653

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Exclusive of limestone, value for which is included under "Miscellaneous."

Mineral production of South Carolina in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons	(a)	(a)	(a)	(a)
Clay products		$1,071,471		$1,272,147
Clay, raw.....short tons	25,706	b 224,415	50,131	b 462,819
Copper.....pounds	2,299	427		
Gold.....troy ounces	4	81	16	332
Marl, calcareous.....short tons	(a)	(a)	(a)	(a)
Mineral waters.....gallons sold	348,242	38,890	246,418	51,112
Phosphate rock.....long tons	60,823	308,968	44,141	367,209
Sand and gravel.....short tons	298,787	157,220	263,630	186,045
Silver.....troy ounces	19	21	1	1
Stone.....short tons	403,780	721,215	272,460	860,000
Miscellaneous		72,623		88,623
Total value, eliminating duplications		2,370,916		2,825,479

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of South Dakota in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products		$73,571		$69,237
Clay, raw.....short tons	(a b)	(a b)	(a b)	(a b)
Coal.....do	14,417	45,707	12,777	46,000
Columbite.....pounds	300	90	4,000	1,450
Gems and precious stones		(a)		(a)
Gold.....troy ounces	235,250	4,863,040	226,224	4,676,470
Gypsum.....short tons	(a)	(a)	(a)	(a)
Lead.....do	16	1,725	6	1,025
Lime.....do	4,205	56,540	(a)	(a)
Lithium minerals.....do	1,727	46,600	(a)	(a)
Mica, scrap.....do	(a)	(a)	(a)	(a)
Mineral waters.....gallons sold	785,404	23,961	(a)	(a)
Natural gas.....M cubic feet	32,807	16,700	19,900	12,260
Sand and gravel.....short tons	648,939	231,390	572,259	253,614
Sand-lime brick.....thousands	(a)	(a)	(a)	(a)
Silver.....troy ounces	116,493	130,472	90,795	98,966
Stone.....short tons	140,400	222,490	196,880	489,753
Tin (metallic equivalent).....do			6	6,000
Miscellaneous		146,918		302,363
Total value, eliminating duplications		5,842,704		5,951,138

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of Tennessee in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Aluminum.....pounds..	(a b)	(a b)	(a b)	(a b)
Barytes.....short tons..	34,700	$288,622	29,319	$213,657
Bauxite.....long tons..	(a)	(a)	(a)	(a)
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	3,447,386	.....	4,446,686
Clay, raw.....short tons..	42,482	b 189,705	110,479	b 603,374
Coal.....do....	5,213,205	14,448,168	6,662,428	26,778,000
Coke.....do....	260,915	b 1,907,670	301,708	b 2,928,557
Copper.....pounds..	15,623,589	2,905,988	16,727,803	3,077,916
Ferroalloys.....long tons..	24,565	b 1,395,327	52,683	b 3,126,143
Gold.....troy ounces..	274	5,662	282	5,830
Iron ore:				
Sold to furnaces.....long tons..	282,988	817,549	373,012	1,355,217
Sold for paint.....do....	(a)	(a)	(a)	(a)
Iron, pig.....do....	155,663	b 5,152,860	217,887	b 9,271,324
Lead.....short tons..	2,188	231,928	1,979	316,560
Lime.....do....	116,346	958,816	119,034	1,098,603
Manganese ore.....long tons..	328	8,388	502	16,436
Manganiferous ore.....do....	35	(a)	.....	.....
Mineral waters.....gallons sold..	752,837	54,259	1,265,286	73,570
Natural gas.....M cubic feet..	77,441	5,400	14,780	3,220
Petroleum.....barrels..	15,000	37,000	14,000	50,000
Phosphate rock.....long tons..	524,333	3,347,692	621,396	4,857,399
Potash (K_2O).....short tons..	(a)	(a)	.....	.....
Pyrites.....long tons..	(a)	(a)	(a)	(a)
Sand and gravel.....short tons..	1,006,708	734,212	1,117,245	1,012,357
Silica (quartz).....do....	(a)	(a)	(a)	(a)
Silver.....troy ounces..	98,288	110,083	110,719	120,684
Stone.....short tons..	677,110	1,762,596	1,098,660	2,962,725
Sulphuric acid c.....do....	(a)	(a)	(a)	(a)
Zinc.....do....	23,247	3,394,062	19,217	3,113,154
Miscellaneous.....	.....	10,360,788	.....	12,389,656
Total value, eliminating duplications.....	.....	37,134,899	.....	55,023,452

a Value included under "Miscellaneous."
b Value not included in total value for State.
c From copper smelting. Figures for 1919 according to Bureau of the Census.

Mineral production of Texas in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	189,377	$2,656,567	261,465	$3,838,295
Cement.....barrels..	2,318,747	4,226,222	2,626,130	5,898,972
Clay products.....	.....	4,452,997	.....	6,298,407
Clay, raw.....short tons..	21,841	a 43,487	3,478	a 23,503
Coal.....do....	1,680,656	4,527,640	1,615,015	6,062,000
Copper.....pounds..	979	182	14,435	2,656
Fuller's earth.....short tons..	(b)	(b)	(b)	(b)
Gems and precious stones.....	.....	(b)	.....	(b)
Gold.....troy ounces..	1	25	.....	.....
Graphite, crystalline.....pounds..	(b)	(b)	(b)	(b)
Gypsum.....short tons..	176,607	1,080,754	220,157	1,439,491
Iron ore.....long tons..	12,300	(b)	.....	.....
Iron, pig.....do....	(a b)	(a b)	.....	.....
Lead.....short tons..	7	696	.....	.....
Lime.....do....	49,831	459,279	56,489	569,135
Mica:				
Scrap.....do....	.....	.....	427	8,995
Sheet.....pounds..	.....	.....	(b)	(b)
Mineral waters.....gallons sold..	328,913	60,125	597,233	91,983
Natural gas.....M cubic feet..	24,496,856	5,144,300	c 25,200,000	c 5,500,000
Natural-gas gasoline.....gallons..	9,336,437	1,772,503	32,956,028	5,770,809
Petroleum.....barrels..	79,366,000	157,729,000	96,868,000	313,781,000
Quicksilver.....flasks..	5,019	453,166	3,436	273,712
Salt.....short tons..	(b)	(b)	91,103	667,835
Sand and gravel.....do....	1,673,119	991,798	2,849,309	2,676,883
Sand-lime brick.....thousands..	(b)	(b)	7,125	113,533
Silver.....troy ounces..	538,642	603,279	511,401	557,427
Stone.....short tons..	650,360	630,584	680,450	890,316
Sulphur.....long tons..	(b)	(b)	(b)	(b)
Miscellaneous.....	.....	5,833,782	.....	15,267,530
Total value, eliminating duplications.....	.....	190,563,015	.....	369,708,979

a Value not included in total value for State.
b Value included under "Miscellaneous."
c Figures preliminary.

Mineral production of Utah in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asphalt.....short tons..	33,992	$406,610	63,522	$659,176
Cement.....barrels..	935,305	1,906,816	1,022,639	2,314,413
Clay products.....	.....	[a] 1,071,997	.....	[a] 1,107,204
Clay, raw.....short tons..	4,124	[b] 16,818	3,814	[b] 16,337
Coal.....do....	4,631,323	12,760,613	6,005,199	19,350,000
Coke.....do....	[b c]	[b c]	[b c]	[b c]
Copper.....pounds..	124,061,807	23,075,496	116,931,238	21,515,348
Diatomaceous earth.....short tons..	[c]	[c]	[c]	[c]
Fluorspar.....do....	[c]	[c]	268	[c]
Gems and precious stones.....	.....	1,500	.....	[c]
Gold.....troy ounces..	104,464	2,159,471	97,454	2,014,556
Gypsum.....short tons..	[c]	[c]	[c]	[c]
Iron ore.....long tons..	44,185	177,327	36,159	151,174
Lead.....short tons..	61,915	6,562,940	70,419	11,267,049
Lime.....do....	6,982	94,027	9,797	151,700
Manganiferous ore.....long tons..	.....	.....	66	[c]
Petroleum.....barrels..	.....	.....	[c]	[c]
Phosphate rock.....long tons..	[c]	[c]	1,875	12,000
Potash (K_2O).....short tons..	4,173	1,153,175	7,738	1,001,678
Salt.....do....	77,336	432,130	75,259	546,186
Sand and gravel.....do....	383,372	190,606	519,655	252,527
Silver.....troy ounces..	11,649,961	13,047,956	13,106,976	14,286,604
Slate.....	.....	400	.....	.....
Stone.....short tons..	318,730	333,342	304,290	509,740
Sulphuric acid [d].....do....	[c]	[c]	[c]	[c]
Uranium and vanadium ores.....do....	333	28,350	1,491	104,033
Zinc.....do....	2,216	323,465	4,079	660,777
Miscellaneous.....	.....	2,323,114	.....	2,497,278
Total value, eliminating duplications.....	.....	64,165,525	.....	76,536,657

[a] Exclusive of pottery, value for which is included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Value included under "Miscellaneous."
[d] From copper smelting. Figures for 1919 according to Bureau of the Census.

Mineral production of Vermont in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Clay products.....	.....	[a]	.....	$186,752
Clay, raw.....short tons..	[a b]	[a b]	4,716	[b] 52,697
Copper.....pounds..	582,468	$108,339	.....	.....
Gold.....troy ounces..	18	377	.....	.....
Lime.....short tons..	37,850	436,000	50,192	716,137
Mineral waters.....gallons sold..	107,600	15,755	88,398	11,079
Sand and gravel.....short tons..	52,323	12,861	41,388	6,856
Scythestones.....do....	[a]	[a]	[a]	[a]
Silver.....troy ounces..	2,214	2,480	.....	.....
Slate.....	.....	2,143,648	.....	3,182,477
Stone.....short tons..	273,130	8,219,459	301,980	10,065,759
Talc.....do....	78,661	665,652	86,489	816,794
Miscellaneous.....	.....	170,333	.....	23,040
Total value, eliminating duplications.....	.....	11,728,052	.....	15,008,894

[a] Value included under "Miscellaneous." [b] Value not included in total value for State.

Mineral production of Virginia in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons..	(a)	(a)	(a)	(a)
Briquets, fuel.....do....	(a b)	(a b)	(a b)	(a b)
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	$2,774,573	.....	$3,335,222
Clay, raw.....short tons..	(a b)	(a b)	12,094	b 131,883
Coal.....do....	9,326,830	23,774,941	11,378,606	45,446,000
Coke.....do....	930,516	b 5,391,367	1,027,788	b 9,106,202
Emery.....do....	(a)	(a)	(a)	(a)
Ferroalloys.....long tons..	14,733	b 2,282,129	(a b)	(a b)
Gems and precious stones.....	.....	.....	.....	(a)
Gypsum.....short tons..	(a)	(a)	(a)	(a)
Iron ore:				
Sold to furnaces.....long tons..	304,920	1,139,349	320,109	1,227,601
Sold for paint.....do....	(a)	(a)	.....	.....
Iron, pig.....do....	288,458	b 9,094,135	390,372	b 16,086,946
Lime.....short tons..	223,768	1,805,627	256,568	2,201,724
Manganese ore.....long tons..	3,928	142,431	2,523	73,929
Manganiferous ore.....do....	9,765	(a)	.....	.....
Marl, calcareous.....short tons..	51,154	176,780	42,510	143,373
Mica:				
Scrap.....do....	578	7,811	(a)	(a)
Sheet.....pounds..	(a)	(a)	179,339	26,189
Millstones.....	.....	(a)	.....	34,676
Mineral paints, zinc and lead pigments .....short tons..	(a b)	(a b)	(a b)	(a b)
Mineral waters..... gallons sold..	1,418,528	143,199	1,248,382	147,600
Pyrites.....long tons..	119,164	891,308	100,545	610,085
Salt.....short tons..	(a)	(a)	(a)	(a)
Sand and gravel.....do....	1,565,592	1,349,148	1,213,827	1,133,279
Slate.....	.....	200,282	.....	251,055
Stone.....short tons..	1,632,960	1,705,749	1,466,920	1,796,620
Talc and soapstone.....do....	17,663	542,022	21,715	729,767
Titanium minerals:				
Ilmenite..... do....	106	2,120	268	(a)
Rutile.....do....	102	20,400	277	(a)
Miscellaneous.....	.....	2,499,038	.....	5,075,583
Total value, eliminating duplications.....	.....	36,799,407	.....	60,161,247

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of Washington in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	(a)	(a)	.....	.....
Briquets, fuel.....do....	(a b)	(a b)	(a b)	(a b)
Cement.....barrels..	1,402,616	$2,868,599	1,806,025	$4,096,227
Clay products.....	.....	1,764,264	.....	2,923,687
Clay, raw.....short tons..	20,518	b 21,964	1,319	b 10,377
Coal.....do....	2,990,447	10,691,222	3,757,093	14,560,000
Coke.....do....	62,546	b 531,160	59,395	b 627,451
Copper.....pounds..	1,676,576	311,843	1,983,134	364,897
Diatomaceous earth.....short tons..	974	14,821	953	12,083
Ferroalloys.....long tons..	(a b)	(a b)	(a b)	(a b)
Gems and precious stones.....	.....	(a)	.....	.....
Gold.....troy ounces..	12,232	252,862	5,847	120,860
Iron ore.....long tons..	2,750	(a)	2,500	(a)
Iron, pig.....do....	(a b)	(a b)	.....	.....
Lead.....short tons..	1,073	113,746	2,894	462,980
Lime.....do....	19,534	232,723	31,033	324,042
Magnesite.....do....	106,206	743,442	221,985	1,664,888
Mineral waters.....gallons sold..	(a)	(a)	(a)	(a)
Platinum.....troy ounces..	.....	.....	8	888
Potash (K_2O).....short tons..	(a)	(a)	.....	.....
Sand and gravel.....do....	1,231,814	536,132	1,976,969	1,016,926
Sand-lime brick.....thousands..	.....	.....	(a)	(a)
Silver.....troy ounces..	259,384	290,510	199,678	217,649
Stone.....short tons..	261,310	423,653	712,680	821,842
Talc.....do....	(a)	(a)	.....	.....
Zinc.....do....	.....	.....	213	34,546
Miscellaneous.....	.....	493,007	.....	528,765
Total value, eliminating duplications.....	.....	18,267,938	.....	26,677,191

a Value included under "Miscellaneous." b Value not included in total value for State.

Mineral production of West Virginia in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Bromine.....pounds..	54,478	$27,852	94,943	$38,749
Calcium chloride.....short tons..	1,692	26,876	4,877	79,493
Cement.....barrels..	(a)	(a)	(a)	(a)
Clay products.....	.....	13,097,598	.....	17,167,843
Clay, raw.....short tons..	71,979	b123,951	86,360	b211,029
Coal.....do....	79,036,553	196,551,015	89,970,707	390,046,000
Coke.....do....	1,413,932	b7,672,593	1,828,336	b16,874,508
Ferroalloys.....long tons..	(a b)	(a b)	(a b)	(a b)
Grindstones and pulpstones.....short tons..	6,092	254,095	9,426	346,872
Iron, pig.....long tons..	250,310	b6,267,067	489,689	b15,927,822
Lime.....short tons..	174,167	1,274,294	193,490	1,813,666
Marl, calcareous.....do....	5,875	17,625	(a)	(a)
Mineral waters.....gallons sold..	271,907	33,796	392,950	39,180
Natural gas.....M cubic feet..	231,336,215	34,700,400	c208,000,000	c31,200,000
Natural-gas gasoline.....gallons..	52,150,045	12,179,638	58,941,488	13,049,551
Petroleum.....barrels..	8,327,000	34,890,000	8,249,000	50,146,000
Salt.....short tons..	18,599	167,529	29,802	348,556
Sand and gravel.....do....	1,183,606	1,750,201	1,547,805	2,513,534
Sand and sandstone (finely ground).....do....	(a)	(a)	(a)	(a)
Stone.....do....	1,995,210	2,270,618	2,459,030	3,155,942
Sulphuric acid d.....do....	(a)	(a)	(a)	(a)
Miscellaneous.....	.....	2,443,835	.....	3,729,565
Total value, eliminating duplications.....	.....	298,168,194	.....	511,813,037

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures preliminary.
d From zinc smelting. Figures for 1919 according to Bureau of the Census.

Mineral production of Wisconsin in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Barytes.....short tons..	(a)	(a)	(a)	(a)
Briquets, fuel.....do....	(a b)	(a b)	(a b)	(a b)
Clay products.....	.....	c$1,203,757	.....	c$1,413,255
Clay, raw.....short tons..	.....	.....	(a b)	(a b)
Coke.....do....	(a b)	(a b)	(a b)	(a b)
Iron ore:				
Sold to furnaces.....long tons..	881,740	3,253,290	1,067,159	4,333,307
Sold for paint.....do....	1,086	(a)	1,645	(a)
Iron, pig.....do....	282,830	b8,320,521	363,588	b12,355,028
Lead.....short tons..	4,214	446,684	2,647	423,520
Lime.....do....	123,620	1,094,725	144,590	1,539,027
Mineral paints, zinc and lead pigments..do....	(a b)	(a b)	(a b)	(a b)
Mineral waters.....gallons sold..	5,113,289	1,446,367	5,259,447	1,601,075
Peat.....short tons..	.....	.....	(a)	(a)
Potash (K_2O).....do....	392	247,496	181	119,542
Pyrites.....long tons..	26,053	19,287	(a)	(a)
Sand and gravel.....short tons..	2,763,249	1,543,434	2,422,689	1,553,622
Sand-lime brick.....thousands..	(a)	(a)	17,157	215,988
Silica (quartz).....short tons..	(a)	(a)	(a)	(a)
Stone.....do....	1,556,880	3,179,894	1,564,940	3,729,236
Sulphuric acid d.....do....	(a)	(a)	(a)	(a)
Zinc.....do....	40,765	5,951,690	27,285	4,420,170
Miscellaneous.....	.....	9,876,530	.....	12,234,975
Total value, eliminating duplications.....	.....	18,772,601	.....	19,630,114

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Exclusive of pottery, value for which is included under "Miscellaneous."
d From zinc smelting. Figures for 1919 according to Bureau of the Census.

Mineral production of Wyoming in 1919 and 1920.

Product.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Asbestos.....short tons..	(a)	(a)	(a)	(a)
Chromite.....long tons..	1,200	$35,620	131	$3,684
Clay products.....	.....	194,350	.....	258,706
Clay, raw.....short tons..	(a b)	(a b)	(a b)	(a b)
Coal.....do....	7,219,738	18,751,024	9,630,271	28,741,000
Copper.....pounds..	139,900	26,021	.....	.....
Gems and precious stones.....	.....	(a)	.....	(a)
Gold.....troy ounces..	4	84	.....	.....
Gypsum.....short tons..	51,079	282,587	57,732	410,724
Iron ore.....long tons..	398,613	(a)	406,501	(a)
Lime.....short tons..	(a)	(a)	(a)	(a)
Manganese ore.....long tons..	.....	.....	40	2,800
Mineral waters.....gallons sold..	(a)	(a)	8,576	1,350
Natural gas.....M cubic feet..	6,013,867	420,970	c6,500,000	c458,500
Natural-gas gasoline.....gallons..	5,580,599	931,722	8,711,037	1,735,828
Petroleum.....barrels..	13,172,000	19,544,000	16,831,000	50,050,000
Phosphate rock.....long tons..	81	300	.....	.....
Platinum and allied metals.....troy ounces..	(a)	(a)	.....	.....
Potash (K_2O).....short tons..	(a)	(a)	(a)	(a)
Sand and gravel.....do....	349,181	40,825	494,423	132,972
Silver.....troy ounces..	151	169	.....	.....
Sodium sulphate from natural sources .....short tons..	(a)	(a)	(a)	(a)
Stone.....do....	118,040	212,608	123,100	230,556
Sulphur.....long tons..	.....	.....	(a)	(a)
Uranium ores.....short tons..	71	27,473	36	2,938
Miscellaneous.....	.....	634,456	.....	664,550
Total value, eliminating duplications.....	.....	41,097,209	.....	82,687,897

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures preliminary.

PREFATORY NOTE TO THE REPORTS ON GOLD, SILVER, COPPER, LEAD, AND ZINC.

By G. F. Loughlin,
Geologist in Charge, Division of Mineral Resources.

In the mining industry gold, silver, copper, lead, and zinc are closely related in both the genesis and the geologic occurrence of their ores, as well as in mining and in metallurgic treatment. Of their ores some contain all five metals, many contain three or four, and few contain only one. Gold and silver, for instance, almost everywhere show close genetic relations, and their ores are usually mined together. Lead and zinc constitute a similar pair. Copper ores almost invariably yield some silver and gold as well as copper, and most lead ores yield notable supplies of silver. Zinc ores in the Western States contribute also to the production of silver. All five metals may occur in commercial quantity in a single mine, or more commonly, in a single mining district. For these reasons each of these metals is treated in Mineral Resources in a general report, and all five metals are grouped together in "mines reports" descriptive of individual or geographically grouped States. These reports are published in 16 separate pamphlets.

To facilitate advance publication each report is published separately at the earliest date possible. The general reports give figures of the output of the metals in the first marketable form, as obtained from the smelters, refineries, and mints, together with general reviews of the respective industries for the entire country. The figures given in the general reports represent the final official statistics of production for the country and of the States. The general report on gold and silver includes the statistics of recovered precious metals as determined jointly by the Bureau of the Mint and the United States Geological Survey. The "mines reports" give figures of the production (called "mine production") as obtained from the mines, so far as possible in terms of recoverable metal in ores and other material sold or treated during the year; they also supply information in detail relative to the mining industry in the respective States, counties, and mining districts.

These reports, which appear as separate chapters in this volume, are as follows:

Gold and silver (general report).
Copper (general report).
Lead (general report).
Zinc (general report).
Gold, silver, copper, lead, and zinc in the Eastern States (mines report).
Silver, copper, lead, and zinc in the Central States (mines report).
Gold, silver, copper, and lead in Alaska (mines report).
Gold, silver, copper, lead, and zinc in Arizona (mines report).
Gold, silver, copper, lead, and zinc in California and Oregon (mines report).
Gold, silver, copper, lead, and zinc in Colorado (mines report).
Gold, silver, copper, lead, and zinc in Idaho and Washington (mines report).
Gold, silver, copper, lead, and zinc in Montana (mines report).
Gold, silver, copper, lead, and zinc in Nevada (mines report).
Gold, silver, copper, lead, and zinc in New Mexico and Texas (mines report).
Gold, silver, copper, and lead in South Dakota and Wyoming (mines report).
Gold, silver, copper, lead, and zinc in Utah (mines report).

In stating quantity of ores, concentrates, and similar material the short ton of 2,000 pounds is used throughout. The term "ore" as used here denotes any metalliferous material treated at the mine or shipped to reduction plants and paid for by those plants, whether or not it nets a profit to the miner. The ore classification is necessarily arbitrary, because of the varying factors affecting mining and treatment of ores. Dry or siliceous ores comprise gold and silver ores proper, as well as fluxing ores that carry considerable quantities of iron and manganese oxides and very small quantities of gold and silver, and also gold and silver ores that carry copper, lead, or zinc in quantities too low to classify them as copper, lead, zinc, or mixed ores. The copper ores include the great disseminated copper deposits of the West, the copper ores of the Lake Superior region, and other ores in which copper is the most abundant base metal paid for. The lead and zinc ores are those in which lead or zinc is the only or chief base metal present, irrespective of their precious-metal content. The mixed ores are those whose commercial value depends on the recoverable or recovered contents of two or more base metals in addition to any precious metals they may contain. If one of the metals, though present in sufficient quantity, is not recovered, that metal is disregarded in naming the ore. An improvement in metallurgy may later serve to change the name of such ore. This classification based on methods of treatment is the only satisfactory commercial classification.

It is to be understood, of course, that market values are not received by producers for metals in ore and intermediate products, nor always for metals in marketable form, that payment is made in accordance with contracts for treatment or sale, and therefore that average daily quotations do not necessarily agree with average prices received.

Any of the reports mentioned here may be obtained, as long as the supply lasts, on request made to the Director, United States Geological Survey, Washington, D. C.

Prices of silver, copper, lead, and zinc, 1850 to 1920.

Year.	Silver.[a]	Copper.[b]	Lead.[c]	Zinc.[d]	Year.	Silver.[a]	Copper.[b]	Lead.[c]	Zinc.[d]
	Fine ounce.	*Pound.*	*Pound.*	*Pound.*		*Fine ounce.*	*Pound.*	*Pound.*	*Pound.*
1850	$1.32	$0.22	$0.05	.....	1886	$0.99	$0.111	$0.046	$0.044
1851	1.34	.166	.05	.....	1887	.98	.138	.045	.046
1852	1.33	.22	.05	.....	1888	.94	.168	.044	.049
1853	1.35	.22	.06	$0.055	1889	.94	.135	.039	.05
1854	1.35	.22	.06	.....	1890	1.05	.156	.045	.055
1855	1.34	.27	.07	.....	1891	.99	.128	.043	.05
1856	1.34	.27	.066	.....	1892	.87	.116	.041	.046
1857	1.35	.25	.06	.....	1893	.78	.108	.037	.04
1858	1.34	.23	.06	.....	1894	.63	.095	.033	.035
1859	1.36	.22	.055	.....	1895	.65	.107	.032	.036
1860	1.35	.23	.056	.....	1896	.68	.108	.03	.039
1861	1.33	.22	.05	.....	1897	.60	.12	.036	.041
1862	1.35	.22	.06	.....	1898	.59	.124	.038	.046
1863	1.345	.34	.06	.....	1899	.60	.171	.045	.058
1864	1.345	.47	.07	.139	1900	.62	.166	.044	.044
1865	1.337	.392	.066	.....	1901	.60	.167	.043	.041
1866	1.339	.342	.07	.....	1902	.53	.122	.041	.048
1867	1.33	.254	.065	.....	1903	.54	.137	.042	.054
1868	1.326	.23	.065	.....	1904	.58	.128	.043	.051
1869	1.325	.242	.06	.....	1905	.61	.176	.047	.059
1870	1.328	.212	.06	.....	1906	.68	.193	.057	.061
1871	1.325	.241	.06	.....	1907	.66	.20	.053	.059
1872	1.322	.356	.064	.....	1908	.53	.132	.042	.047
1873	1.297	.289	.06	.....	1909	.52	.13	.043	.054
1874	1.278	.220	.06	.....	1910	.54	.127	.044	.054
1875	1.24	.227	.058	.07	1911	.53	.125	.045	.057
1876	1.16	.21	.061	.072	1912	.615	.165	.045	.069
1877	1.20	.19	.055	.05	1913	.604	.155	.044	.056
1878	1.15	.166	.036	.049	1914	.553	.133	.039	.051
1879	1.12	.186	.041	.052	1915	.507	.175	.047	.124
1880	1.15	.214	.05	.055	1916	.658	.246	.069	.134
1881	1.13	.182	.048	.052	1917	.824	.273	.086	.102
1882	1.14	.191	.049	.053	1918	1.00	.247	.071	.091
1883	1.11	.165	.043	.045	1919	1.12	.186	.053	.073
1884	1.11	.13	.037	.044	1920	1.09	.184	.08	.081
1885	1.07	.108	.040	.043					

[a] Report of Director of the Mint, pp. 212–213, 1914. Equivalent value of fine ounce based on average price and average rate of exchange. For 1916, 1917, and 1919 dealers' buying price, New York. For 1918 average price as stated by the Bureau of the Mint. For 1920 New York price for domestic silver only.

[b] Weed, W. H., Copper Handbook, vol. 11, pp. 1339, 1343, for years 1850–1903. By computation from data for years 1850–1860, p. 1338. Survey computations for electrolytic copper since 1904. For 1916 and later years average price all marketable grades.

[c] New York price, Ingalls, W. R., Lead and zinc in the United States, p. 203, 1908. U. S. Geological Survey since 1904. For 1916, outside spot quotations, New York. For 1917 and later years average price all grades.

[d] New York price, 1875–1904, Ingalls, W. R., Lead and zinc in the United States, p. 342, 1908. St. Louis price, U .S. Geological Survey, since 1904. For 1915 and later years average price all grades. Oral communication from C. E. Siebenthal for 1855 and 1864.

CADMIUM.

By C. E. Siebenthal and A. Stoll.

INTRODUCTION.

An account of the production, resources, metallurgy, and uses of cadmium was given as a chapter in Mineral Resources for 1908. Another account describing in some detail the cadmium-bearing by-products produced in the United States and their possibilities as commercial sources of cadmium and giving the results of attempts to substitute cadmium for tin in solders was included in the chapter on cadmium in Mineral Resources for 1918. A more detailed report is in preparation and will be published as a bulletin of the United States Geological Survey.

The present report gives the production of cadmium in the United States since the beginning of the industry in 1906, the imports for 1903 and later years, the range of fluctuation in price in 1920, and the yearly average selling price since 1906.

PRODUCTION.

There are several cadmium minerals, but none of them occur in quantities large enough to be called ores. The cadmium of commerce is derived from zinc minerals and ores, in almost all of which it occurs in minute quantity, the ratio being about 1 of cadmium to 200 of zinc. Cadmium behaves metallurgically almost the same as zinc and hence constitutes a fraction of 1 per cent of almost all metallic zinc. The sources of cadmium that have been utilized are zinc ores treated by fractional distillation, lead-furnace bag-house "fumes" (the cadmium content of which is derived from the zinc minerals contained in the charge of lead ore), and residues from the purification vats of electrolytic zinc plants and lithopone plants. These sources and their possibilities as to yield in cadmium were discussed in some detail in the chapter on cadmium in Mineral Resources for 1918 and are briefly considered on a later page of this chapter. The production of cadmium, either as the metal or as the sulphide, has been reported by the companies in the following list, which shows also the nature of the metallurgic plant in connection with which the cadmium plant is operated:

Producers of cadmium in the United States in 1920.

Company.	Location of plant.	Associated plant.
American Smelting & Refining Co	Denver, Colo	Lead smelter.
Grasselli Chemical Co	Cleveland, Ohio	Chemical works.
Krebs Pigment & Chemical Co	Newport, Del	Lithopone plant.
Midland Chemical Co	Argo, Ill	Do.
U. S. Smelting, Refining & Mining Co	Kennett, Calif	Electrolytic zinc plant.
Do	Midvale, Utah	Lead smelter.

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Of these, the plant at Kennett, Calif., was reported to have made no output in 1920. The lead furnaces at the Globe plant of the American Smelting & Refining Co., at Denver, have been closed for some years, but stocks of cadmiferous residues remain from former operations, and more has been shipped in from other plants of the company.

Several other electrolytic zinc plants and lithopone plants save cadmium-bearing residues and have worked out processes for recovering the metal, so that an extension of the uses of cadmium and an increased demand for it would result in additions to the list of producers. Several companies that produce cadmium-bearing residues sell them to the producing companies named above.

The following table, compiled from reports by each producer of cadmium in the United States and from official reports of the German Government, shows that the production of cadmium in the United States since 1910 has gained rapidly on that of Germany. Taken together the production of these two countries has constituted practically the whole cadmium production of the world, though a small output is being made at the electrolytic zinc plants of Brunner, Mond & Co. and Chance & Hunt, in England.

Metallic cadmium and cadmium sulphide produced in the United States and Germany, 1906–1920.

Year.	United States.						Germany.		
	Metallic cadmium.			Cadmium sulphide.			Metallic cadmium.		
	Quantity (pounds).	Value based on sales.	Average price per pound.	Quantity (pounds.)	Value based on sales.	Average price per pound.	Quantity (pounds).	Value.	Average price per pound.
1906	300	$300	$1.00	(a)	.....	.....	47,368	$36,083	$0.76
1907	14,000	14,350	1.025	(a)	.....	.....	72,639	60,757	.84
1908	8,000	6,000	.75	(a)	.....	.....	72,741	48,590	.67
1909	5,300	2,783	.525	(a)	.....	.....	81,982	46,777	.57
1910	4,700	2,585	.55	(a)	.....	.....	90,516	39,309	.43
1911	26,152	17,566	.67	2,392	$1,671	$0.70	93,861	53,372	.57
1912	52,508	39,875	.76	8,998	6,400	.71	94,262	63,507	.67
1913	54,198	41,838	.77	17,302	12,136	.70	81,993	63,641	.78
1914	[b] 91,409	81,205	.89	22,723	20,241	.89	[c] 86,000	.....	[c] M. 2.97
1915	91,415	108,443	1.19	10,624	12,057	1.13	[c] 82,000	.....	[c] 2.92
1916	135,212	210,931	1.56	22,176	27,942	1.26	[c] 128,000	.....	[c] 4.79
1917	207,408	305,097	1.47	50,169	70,939	1.41	[c] 172,000	.....	[c] 6.74
1918	127,164	188,203	1.48	51,702	70,315	1.36	[c] 236,000	.....	[c] 6.31
1919	99,939	121,926	1.22	31,197	37,436	1.20	[c] 85,395	.....	[c] 16.51
1920	129,283	151,261	1.17	32,133	37,274	1.16	(d)	.....	.....
	1,046,988	1,292,363	.....	249,416	296,414	.....	.....	.....	.....

[a] No production.
[b] Exclusive of 4,225 pounds of cadmium in residues sold for export.
[c] Statistics of production and average selling price for 1914–1919 from Glückauf, vol. 56, pp. 818–819, 1920. The value is expressed in marks because the exchange value of the mark is not available for part of the period.
[d] Figures not available.

CONDITION OF CADMIUM INDUSTRY.

The production of cadmium in 1920 increased nearly 30 per cent, but there was also an increase in sales, which reached practically the record figure established in 1916, so that in 1920, as in 1919, the sales exceeded the output, and the stocks that yet remained from the large output in 1917–18 were notably reduced. The consumption of cad-

mium for the period 1916 to 1920, inclusive, as judged from the sales, has averaged about 127,000 pounds annually.

RESOURCES AND REDUCTION CAPACITY.

In 1918 a canvass was made of lead smelters, electrolytic zinc reduction and refining plants, lithopone plants, and a few typical brass works, with the object of ascertaining the yearly recovery of cadmium in fumes and residues, the accumulated stocks of such materials, and the maximum yearly capacity of the cadmium-reduction plants.

According to the data obtained, cadmium is accumulating at lead smelters at the rate of 350 to 400 short tons annually, and the stocks of bag-house fumes contained more than 750 tons of cadmium. At electrolytic zinc plants about 200 tons is accumulating annually and the stocks of residues contained about 400 tons. At lithopone plants probably 50 tons is produced annually and about 25 tons was contained in stocks. In round numbers, then, 600 short tons accumulates annually, and there was on hand in 1918 approximately 1,200 tons in stocks of fumes and residues. Not all the stocks are rich enough for the cadmium to be commercially recovered, but perhaps material that carries 1,000 tons is suitable for treatment. The average recovery of cadmium is about 75 per cent. We may therefore estimate that 750 tons of recoverable cadmium in residues was in stock in 1918. At some electrolytic zinc plants the cadmium in the residues is wasted in recovering copper and lead.

The maximum capacity for metallic cadmium reported by producers is 29,000 pounds a month, or about 175 tons a year. If the price of cadmium and the demand for it should justify expansion, the producing capacity could no doubt be brought up with reasonable promptness to 500 short tons or more yearly. The price of cadmium will be the deciding factor also in determining what grade of cadmium fumes can be worked at a profit.

IMPORTS.

Cadmium was imported into the United States, before the World War, as metallic stick cadmium and as the pigment, cadmium sulphide. The former is free of duty; the latter is dutiable at 30 per cent ad valorem. The value of the metallic cadmium imported for consumption from 1903 to 1920, inclusive, is given in the following table, which is taken from the records of the Bureau of Foreign and Domestic Commerce. The quantities are not there recorded prior to July, 1909, and for the period preceding that time they have been computed by dividing the values of the imports by the average price of cadmium for the corresponding year in Germany, from which the cadmium was imported. No cadmium was imported in 1916 to 1920, inclusive. The quantity and value of cadmium imported as a pigment are not recorded separately by the Bureau of Foreign and Domestic Commerce.

Cadmium imported and entered for consumption in the United States, 1903–1920.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1903	[a] 8,679	$4,565	1912	5,250	$3,764
1904	[a] 7,655	4,524	1913	1,656	1,232
1905	[a] 8,138	5,298	1914	441	368
1906	[a] 13,808	10,522	1915	269	284
1907	[a] 1,953	1,633	1916	.....	.....
1908	[a] 3,567	2,390	1917	.....	.....
1909 first half	[a] 6,659	4,559	1918	.....	.....
1909 second half	2,203		1919	.....	.....
1910	4,060	2,295	1920	.....	.....
1911	5,367	3,870			

[a] Prior to July, 1909, the quantities are computed as noted on p. 3.

EXPORTS.

Statistics of the exports of cadmium are not separately kept by the Bureau of Foreign and Domestic Commerce, Department of Commerce, and hence are not regularly available, but it is known that domestic cadmium was largely exported during the World War. Special canvasses show that about 40,000 pounds of cadmium was exported in 1918, of which the larger part went to France. Such figures of exports as are available are given in the chapter on cadmium in Mineral Resources of the United States for 1919.

PRICES AND VALUE.

The price quoted for cadmium in sticks and small bars in the first six months of 1920 was nominal at $1.40 a pound; for the next five months it ranged from $1.40 to $1.50 a pound; and during the last month it was constant at $1.40 a pound. Cadmium sales are so irregular, however, that the quotation is nominal much of the time, and sales in large lots are made at figures considerably under the quotations. The average selling price of metallic cadmium for 1920 as calculated from actual sales was $1.17, compared with $1.22 in 1919 and with $1.48 in 1918. The average selling price of cadmium sulphide in the United States in 1920 was $1.16 a pound, as compared with $1.20 in 1919 and with $1.36 in 1918.

The value of the output of cadmium in the United States in 1920, calculated at the average selling price, was $151,261, as compared with $121,926 in 1919, and the value of the cadmium sulphide produced was $37,274, as against $37,436 in 1919.

The total value of the output of metallic cadmium in the United States since the beginning of production in 1906 is $1,292,363, and that of cadmium sulphide is $296,414, making a total of $1,588,777.

USES.

Cadmium is used in metallic form chiefly in alloys, and its salts are used in the arts, in medicine, and in electroplating.

CADMIUM METAL AND ALLOYS.

The alloys of cadmium most generally used are the easily fusible alloys used in the tips of automatic sprinklers, in safety plugs for

boilers, and in electric fuses; cadmium cliché metal for stereotype plates; and solders in which cadmium is substituted for part or all of the tin commonly used.

A fraction of 1 per cent of cadmium is used as a deoxidizer in making bronze telegraph and telephone wires and cables in France and Italy. The larger part of the cadmium exported from the United States goes to France, as has already been noted. Cadmium is also used as a deoxidizer in making nickel alloys and may serve a like purpose in making brass.

A newer use for cadmium is in making small-arms ammunition. A cadmium band on the hard-jacketed cartridge ball takes the rifling with little wear on the barrel and thus prolongs the life of the gun.

SALTS OF CADMIUM.

The sulphide of cadmium is the brilliant pigment cadmium-yellow or jaune brillant. Properly prepared it is one of the most permanent pigments known, and it is unaffected by hydrogen sulphide gas from coal smoke, whereas the common yellow pigments (lead chromes) are blackened in a smoky atmosphere. Cadmium-yellow is therefore employed as a protective coating over chrome-yellow in painting street cars and the passenger coaches on some railway lines.

Sulphide of cadmium is extensively used to give color and luster to glass and porcelain, and other cadmium salts are used in dentistry, dyeing, and photography.

So-called "cadmium lithopone," which is analogous to lithopone and in which cadmium replaces the zinc, has been experimentally known for some years. Hanley [1] says:

> It is believed that the pigment industry offers a good prospective field for the consumption of cadmium compounds. Cadmium-yellows and cadmium lithopone constitute the principal forms used, and the persistence of the color is a favorable feature of these pigments. They can therefore be used advantageously in an atmosphere vitiated with sulphur smoke, whereas the chrome-yellows darken under similar conditions. Cadmium has long been used by artists who require beautiful and persistent yellow or orange tints. The sulphide, which is the form used in paints, will stand considerable dilution with a transparent thinner, such as heavy spar, without losing the intensity of the yellow color. It may be possible, therefore, to develop a color using this pigment that could compete in price with cheaper yellows. This proposition would require development by experienced paint chemists in order to be definitely established. The shade of color can be quite accurately controlled from light yellows to deep vermilions by regulating by hydrogen sulphide the acidity of the cadmium sulphate solution from which it is precipitated. Consequently the color required by the trade could be consistently duplicated.

Cadmium electroplating is a field that offers some promise of expansion. Cadmium is a better rust preventive than nickel, and at more nearly a parity in prices cadmium plating might be substituted for nickel plating on some articles. Or, as it has a greater tendency to tarnish than nickel, it might be used in combination with nickel, the first coat consisting of the rust-preventive cadmium and the second coat of the tarnish-proof nickel.

The Udylite Process Co., of Kokomo, Ind., has developed a commercial method for electroplating iron and steel articles with cadmium and is prepared to grant licenses for its use.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES.

(MINES REPORT.)

By J. P. Dunlop.

MINE PRODUCTION.

The total value of the gold, silver, copper, lead, and zinc mined and sold in the Eastern States in 1920 was $24,014,717, a decrease of about 8 per cent from the corresponding value in 1919. Of this total gold represented $8,515; silver, $122,279; copper, $3,153,516; lead, $320,246; and zinc, $20,410,161.

As will be seen from the following table, the output of lead and zinc decreased, and the increases in quantity of gold, silver, and copper were comparatively small. The decrease in total value of the metals was caused mainly by the decreased output of zinc.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1919 and 1920

Year.	Ore sold or treated.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	1,930,411	$7,052	104,690	16,596,182	4,378,000	242,558,000	$26,110,186
1920	2,418,500	8,515	112,183	17,138,675	4,003,078	204,484,000	24,014,717
Increase or decrease, 1920	+488,089	+1,463	+7,493	+542,493	−374,922	−38,074,000	−2,095,469

GOLD.

Of the output of gold in 1920 the placers yielded $1,182, the siliceous gold ores $756, the copper ores $5,830, the lead ores $178, and the copper-lead ores $569. The deep and placer gold mines which in former years yielded nearly all the gold in the Eastern States supplied only 23 per cent in 1920, and the minor character of the operations at such mines is best shown by the fact that the total output of $1,938 was derived from 10 properties. The small quantity of siliceous ore mined was treated in small mills by amalgamation, and none of the large mills or cyanide plants were operated. Most of the ore is of low grade, and the continued high cost of supplies and the scarcity and inefficiency of available labor prevented profitable mining. About 77 per cent of all the gold was obtained in refining copper and lead bullion—the only uninterrupted source of gold in these States in the last four years. It is probable that

lower wages and a decreased demand for labor in other industries will result in increased operations at small placers and deep gold mines and that in 1921 there will be a considerable increase in the quantity of gold produced from the working of scattered diggings and purchased by banks and merchants, but it is improbable that there will be any marked increase in the output of the large mines in 1921.

SILVER.

Nearly 99 per cent of the output of silver in 1920 was derived from copper ores, and all the remainder except 21 ounces came from lead and copper-lead ores. No silver was recovered from zinc ores, and the silver contained in bullion from placer mines was only 5 ounces.

Mine production of gold and silver in the Eastern States in 1920, by States.

State.	Gold.		Silver.		Increase or decrease in value compared with 1919.	
	Quantity.	Value.	Quantity.	Value.	Gold.	Silver.
	Fine ounces.		*Fine ounces.*			
Alabama	14.32	$296	9	$10	+ $296	+ $10
Georgia	35.41	732	194	211	− 35	+ 202
Maine and Vermont					− 522	− 7,119
Massachusetts and Pennsylvania	8.61	178	1,250	1,362	+ 178	+ 1,362
North Carolina and South Carolina	71.55	1,479	11	12	+1,378	− 30
Tennessee	282.02	5,830	110,719	120,684	+ 168	+10,601
Total, 1920	411.91	8,515	112,183	122,279		
Total, 1919	341.14	7,052	104,690	117,253		
Increase, 1920	70.77	1,463	7,493	5,026		

Mine production of gold and silver in the Eastern States in 1920, by sources, in fine ounces.

State.	Gold.				Silver.			
	Placers.	Dry or siliceous ores.	Copper ores.	Lead and copper-lead ores.	Placers.	Dry or siliceous ores.	Copper ores.	Lead and copper-lead ores.
Alabama		14.32				9		
Georgia		7.89		27.52		1		193
Massachusetts and Pennsylvania				8.61			90	1,160
North Carolina and South Carolina	57.18	14.37			5	6		
Tennessee			282.02				110,719	
Total, 1920	57.18	36.58	282.02	36.13	5	16	110,809	1,353
Total, 1919	34.59	5.32	301.23		8	2	104,680	

COPPER.

The mine production of copper in the Eastern States in 1920 was valued at $3,153,516, an increase of $66,626. Of this copper 16,727,803 pounds was derived from Tennessee copper ores, 5,780 pounds from Georgia copper-lead ores, and 405,092 pounds from Pennsylvania pyritiferous magnetite ore.

The total quantity of ore treated to produce this copper was 1,297,293 tons. Exclusive of the magnetite ore, which was mined for its iron content and contained very little copper, the average yield of copper was approximately 1.45 per cent, or 29 pounds to the ton, and this copper ore also yielded $0.21 in gold and silver per ton. Copper ores directly smelted amounted to 590,093 tons, from which 16,727,803 pounds of copper was recovered. Copper, lead, and pyritiferous magnetite ores concentrated amounted to 707,440 tons, which yielded 13,872 tons of concentrates containing 410,872 pounds of copper and small quantities of gold and silver.

LEAD.

The mine production of lead in the Eastern States in 1920 was valued at $320,246, an increase of 38 per cent, though the quantity decreased about 9 per cent. Tennessee produced 3,957,000 pounds, Massachusetts 27,578 pounds, Pennsylvania 14,700 pounds, and Georgia 3,800 pounds. The quantity of lead ore treated was 9,514 tons, which yielded 3,999,278 pounds of lead, or about 21 per cent. The remainder of the lead was derived from copper-lead ore. The lead ore mined in Tennessee carried no gold or silver, but the lead ore mined in Massachusetts and Pennsylvania and the copper-lead ore mined in Georgia, amounting in all to 698 tons, yielded $3.32 a ton in gold and silver.

ZINC.

The recoverable production of zinc in the Eastern States in 1920 was valued at $20,410,161, a decrease of $2,256,796. New Jersey produced 154,742,000 pounds, Tennessee 38,434,000 pounds, and New York 11,308,000 pounds. Zinc ore mined and treated amounted to about 1,100,000 tons, of which 535,207 tons was from New Jersey and 53,780 tons from New York. Nearly all the zinc ore from Tennessee and New York was sent to concentrating plants, and 479,425 tons of the zinc ore from New Jersey was concentrated and the remainder shipped as crude ore.

REVIEW BY STATES.

ALABAMA.

The value of the gold produced by mines in Alabama during the period 1830 to 1920 was $766,632. The total production by years for Alabama, 1830 to 1918, has been published.[1]

In 1920 the production of gold amounted to $296 and that of silver to 9 ounces, valued at $10. Old properties, such as the Gold Log and Gold Ridge and other mines in Cherokee, Randolph, and Tallapoosa counties, were idle. Most of the output came from a prospect near Jemison, in Chilton County, operated by C. P. Ludwig. The ore was mined from an open cut and milled in a 10-stamp mill using amalgamation. The plant was closed after three months' operation, as the ore proved too low in grade.

[1] Director of the Mint Ann. Rept., 1920, p. 60.

GEORGIA.

The value of the gold produced in Georgia during the period 1830 to 1919 was $17,824,536,[1] or more than one-third of the estimated total production of the southern Appalachian States.

In 1920 mines in Georgia produced 35.41 ounces of gold, valued at $732, 194 ounces of silver, 5,780 pounds of copper, and 3,800 pounds of lead, a decrease of $35 in the value of gold and an increase of 186 ounces in the quantity of silver, as compared with 1919.

Small quantities of gold and silver were reported from mill clean-ups or from prospect work, and very little siliceous ore was milled. Most of the gold and silver was derived from copper-lead ore.

No placer production was reported from Haralson, White, and Lumpkin counties.

Some development work was done at the Barton placer by F. L. Stone, of Dahlonega, but no production was reported.

None of the mines and mills in McDuffie County were operated in 1920, but some prospect work was done by the Rabun Mining & Development Co. near Burton, in Rabun County.

The only mine in Georgia that produced any considerable output was the Magruder mine of the Georgia Copper Co., near Lincolnton, in Lincoln County. Copper-lead concentrates containing considerable gold and silver were shipped to smelters. The mine, which was operated for about three months, is opened by a vertical shaft 245 feet deep and is equipped with a 10-stamp mill and flotation plant.

MAINE, MARYLAND, NEW HAMPSHIRE, AND VERMONT.

Apparently none of the gold or copper mines in Maine, Maryland, New Hampshire, or Vermont were operated in 1920.

MASSACHUSETTS.

At the old Chipman mine, at Highfield, Essex County, Mass., which was reopened in 1919 by the Merrimac Development Co., prospecting was continued throughout 1920. The property is not equipped with a reduction plant but has adequate surface equipment for mining and shipping crude ore. The mine is opened by a 220-foot vertical shaft and 2,100 feet of drifts and raises. Six hundred feet of drifts were run in 1920. Several carloads of lead sulphide ore containing silver and gold were shipped to smelters. A brief but comprehensive report, written by G. F. Loughlin, of the workings of the mine and the character of the ore is contained in the chapter on gold, silver, copper, lead, and zinc in the Eastern States in 1919, copies of which may be obtained upon application to the Director, United States Geological Survey, Washington, D. C.

NEW JERSEY.

The production of zinc ore in New Jersey in 1920 was, as usual, confined to the output of the Mine Hill and Sterling mines at Franklin Furnace, Sussex County. The crude ore produced at those mines in 1920 amounted to 535,207 tons, which yielded a total of 154,742,000

[1] Director of the Mint Ann. Rept., 1920, p. 60.

pounds of recoverable zinc. The crude ore produced in 1919 amounted to 615,680 tons and the recoverable production of zinc was 185,824,000 pounds. It should be understood that only part of the zinc ore mined at Franklin Furnace is used directly for the manufacture of zinc. The greater part of this zinc is normally converted into oxide at works in Pennsylvania.

NEW YORK.

The quantity of zinc ore from New York treated in 1920 was 53,780 tons, which yielded about 11,308,000 pounds of zinc. The Northern Ore Co., operating the Brown mine, near Edwards, St. Lawrence County, treated most of this ore. A vertical shaft 900 feet deep and an 800-foot inclined shaft were operated. Extensive prospecting was done with a diamond-core drill on the large tract of land owned by the company, and the drill was also used in the workings to locate ore and reduce the amount of drifts run.

Ore now being extracted from levels at 840 to 860 feet is dropped to the 900-foot level, hoisted, and trammed by means of a gasoline motor to the mill. The mill, which is constructed of steel and tile, is equipped with crusher, rolls, Dorr thickener, and 17 tables. The ore had been treated by flotation, prior to 1919, but that process is not now in use. No jigs are used, and the concentrates recovered are exclusively a table product, though experiments made by Mr. Wade, the superintendent, resulted in an increased quantity of ore being treated. The table concentrates, which assay about 32 to 33 per cent of zinc, are treated by 13 Electric Ore Separating Co. machines, which, by removing much of the pyrite, raise the zinc content to 48 to 52 per cent. These electric machines treat wet concentrates, and, to avoid the clogging of the riffles in the separator and insure their proper operation, it is necessary to remove by means of a powerful magnet all the small particles of metallic iron abraded from the rolls and crusher.

The average zinc assay of the crude ore treated ranges from 15 to 20 per cent, and the finished concentrates, which are practically free from lead, usually average about 48 per cent. The developed bodies of ore are large, and it is probable that others will be mined on the large tract owned by the Northern Ore Co.

The Hyatt Ore Corporation opened a new mine at Hyatt, 3 miles west of Edwards, and sunk a 320-foot inclined shaft on ore very similar to that of the Northern Ore Co. The 100-ton plant erected in 1920 contains crusher, rolls, jigs, and tables and was operated from October to the end of the year. The concentrates produced are similar in character and zinc content to the table product of the Northern Ore Co. prior to its treatment by Electric Ore Separating Co. machines.

The Empire State property, near Ellensville, Ulster County, which was idle in 1920, has been acquired by John H. Thomas and may be worked in 1921.

NORTH CAROLINA.

The value of the gold produced in North Carolina during the period 1799 to 1919 was $23,628,433.[1] In 1915 the recovery of gold was $172,001, but increased costs of mining and milling the low-grade

[1] Director of the Mint Ann. Rept., 1920, p. 60.

ores and gravels in 1916 and succeeding years made operation so unprofitable that mining has been nearly discontinued. In 1920 the recovery was $1,147 in gold and 10 ounces of silver, valued at $11. Part of the output came from clean-ups at old milling plants, but most of the gold was derived from the Iola mine, near Candor, Montgomery County, and from the Alston property, near Inez, Warren County. None of the deep mines in Moore, Randolph, Catawba, Davidson, and Rowan counties had any output. A little prospect work was done at the Rich Cog mine in Montgomery County.

The Carolina Minerals Co. operated the old Iola mine, near Candor. Log washers were installed for treating old tailings. A small mill may be erected to treat the waste dump at No. 2 shaft. The mine was formerly equipped with a 50-ton cyanide plant, which was moved when the mine was closed in 1915.

The El Oro Mining Co. did a little development work near Hemp, Moore County, but treated no ore. The erection of a 30-stamp mill and concentrating equipment near Franklinville, Randolph County, was commenced by A. J. Overton. Large bodies of low-grade ore are reported to have been opened by means of open cuts.

PENNSYLVANIA.

The Cornwall iron mines, in Lebanon County, Pa., operated by the Bethlehem Steel Co., produced several thousand tons of a low-grade copper concentrate from pyritiferous magnetite ore in 1920. The concentrates, which were shipped to smelters, contained 32.87 per cent of sulphur and 2.96 per cent of copper. Development work was done in 1920 at an old mine near Phoenixville, in Chester County. The property was reopened by the Eastern Mining & Melting Co., and a 100-ton concentrating plant was constructed. Both galena and sphalerite concentrates were recovered, and some of the galena concentrates averaging 80.2 per cent of lead and 8 ounces of silver to the ton were shipped. The sphalerite concentrates, which averaged about 60 per cent of zinc and 3.6 ounces of silver to the ton, were not sold in 1920.

SOUTH CAROLINA.

Mines in South Carolina yielded gold valued at $5,181,510 during the period 1829 to 1919.[2]

There were no deep or placer mines that reported any output of gold in 1920, and the entire output of $332 in gold and 1 ounce of silver consisted of nuggets picked up on farms in Spartanburg and Abbeville counties.

The closing of the smelter at Norfolk, Va., cut off the most available plant for treatment, so that no copper ore was mined or shipped from the mines near Smyrna, in York County.

TENNESSEE.

The value of gold produced at mines in Tennessee during the period 1831 to 1919 was $258,672.[2] A large part of the output prior to 1879 was derived from placer mines, but the output since 1906 has been recovered entirely from copper ore mined in Polk County.

[2] Director of the Mint Ann. Rept., 1920, p. 61.

The annual production of silver has ranged from 56,000 ounces to more than 100,000 ounces since 1905, and that of copper from 14,500,000 to 19,459,000 pounds. No production of lead was reported prior to 1915, but since that time the mines in Tennessee have yielded 16,840,000 pounds. The output of zinc, which was only 218,643 pounds in 1907, amounted to 57,000,000 pounds in 1917, and the total production from 1907 to 1920 has been 312,505,000 pounds.

Mine production of gold, silver, copper, lead, and zinc in Tennessee, 1905–1920.

Year.	Ore sold or treated.	Gold.	Silver.	Copper.	Lead.	Zinc.	Total value.
	Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1905	399,330	$4,362	95,522	14,541,425	.....	.....	$2,330,606
1906	538,141	4,838	55,931	17,979,317	.....	.....	3,512,320
1907	561,805	3,825	58,358	18,893,115	.....	218,643	3,833,864
1908	638,033	3,699	57,696	19,459,501	.....	688,149	2,635,275
1909	611,014	4,118	57,637	19,206,806	.....	1,192,161	2,595,350
1910	578,434	3,113	81,239	16,837,727	.....	1,932,555	2,289,731
1911	604,538	11,621	106,660	18,850,276	.....	2,234,000	2,551,774
1912	635,576	8,265	89,893	18,483,173	.....	4,381,300	3,415,583
1913	823,645	7,595	108,105	19,390,750	.....	11,166,000	3,703,752
1914	1,011,058	6,194	97,402	18,737,656	.....	20,850,000	3,615,516
1915	1,149,364	6,862	100,543	18,046,010	1,660	32,922,902	7,298,406
1916	1,184,821	5,739	94,701	14,679,794	32,960	52,855,480	10,764,189
1917	1,533,983	5,326	99,053	16,033,749	5,061,937	56,995,107	10,712,985
1918	1,159,971	4,866	93,620	14,799,680	3,410,400	42,141,311	7,831,005
1919	1,227,534	5,662	98,288	15,623,589	4,376,000	46,494,000	6,647,723
1920	1,120,995	5,830	110,719	16,727,803	3,957,000	38,434,000	6,634,144
	13,778,242	91,915	1,405,367	278,290,371	16,839,957	312,505,608	80,372,223
Increase or decrease, 1920	−106,539	+168	+12,431	+1,104,214	−419,000	−8,060,000	−13,579

Polk County.—The entire output of copper, gold, and silver in Tennessee came from the two large copper mines in the Ducktown district, and the production of all three metals was larger in 1920 than in 1919. The Tennessee Copper Co. operated its 2,000-ton smelter, converter, and sulphuric acid plant on crude sulphide ores from the Burra Burra, London, and Polk County mines. The pig copper was shipped to the Baltimore Copper Smelting & Refining Co. for refining. The annual report of the Tennessee Copper Co. for the calendar year 1920 says:

The Burra Burra, London, and Polk County mines were operated continuously throughout the year, and in August, on account of the shortage of ore, due to the scarcity of labor, a lease was taken on the property of the Copper Pyrites Corporation, which is situated in the Ducktown Basin, and from this property we mined about 135 tons per day until the end of the year. This ore was very high in sulphur, but low in copper, and was mined in order to supplement our own ore and keep uniform our production of sulphuric acid.

The development work at the Burra Burra and London mines has been pushed vigorously throughout the past year, and both mines are in much better condition than they have been for some years past.

In order to overcome the periodical shortage of labor at the mines which we experienced in the summer months, two mechanical ore loaders were installed in the Burra mine and were operated successfully until the end of the year. During the last quarter of the year approximately 25 per cent of the tonnage from Burra mine was mechanically loaded. The grade of ore on both the tenth and twelfth levels at Burra mine is better than we had anticipated.

Plans have been made and the work has been started to open up the Eureka mine and have it ready for operation in case the demand for sulphuric acid should require additional high-grade sulphide ore.

Operations.—The following is a summary of the results of operations at the various mines during the year:

	Burra Burra.	London.	Polk County.	All mines.
Development:				
Raises and winzes.....feet..	2,530.5	738.5	230.5	3,499.5
Crosscuts.....do....	145.5	87.0	.....	232.5
Stations.....do....	60.0	30.0	.....	90.0
Drifts.....do....	2,806.5	845.0	.....	3,651.5
Shafts—McPh., 8.0; Burra, 168.5.....do....	176.5	.....	.....	176.5
	5,719.0	1,700.5	230.5	7,650.0
Diamond drilling:				
Total holes.....do....	13	.....	.....	13
Feet drilled.....	2,079.0	.....	.....	2,079.0
Cost per foot.....	$3.50	.....	.....	$3.50
Ore production and costs:				
Tonnage.....	322,603	82,693	21,374	426,670
Mining per ton.....	$1.4697	$1.9999	$2.5869	$1.6285
Development per ton.....	.3975	.4832	.1183	.4001
Total cost per ton.....	$1.8672	$2.4831	$2.7052	$2.0286
Estimated ore reserves:				
Available tonnage.....	3,327,598	149,986	55,550	[a] 3,533,134
Broken ore in stopes, tons (included in above).....	170,000	9,100	5,000	[a] 184,100

[a] Does not include Eureka mine.

Smelting.—Smelting operations for the year 1920 showed a marked improvement over 1919. The metallurgical results were very good, notwithstanding the fact that the furnaces were run with the idea of furnishing a good grade of gas to the acid plants as a first consideration.

Copper production.—There were smelted during the year 404,060 tons of Tennessee Copper Co. ore which yielded 10,358,237 pounds of fine copper, or an extraction of 25.635 pounds of fine copper per ton of ore smelted. In addition to the above, 116,644 pounds of fine copper were recovered from other than Tennessee Copper Co. ore, making a total production of 10,474,881 pounds of fine copper.

The total cost per ton of Tennessee Copper Co. ore was $4.884, equal to 19.135 cents per pound of fine copper, subdivided as follows:

Mining expense.....	$0.07858
Railway expense.....	.00911
Smelting expense.....	.07049
Converter expense.....	.01062
General expense.....	.02255
Total operating costs per pound of fine copper from Tennessee ores (exclusive of New York charges).....	.19135

The Ducktown Sulphur, Copper & Iron Co. operated its two 600-ton blast furnaces and 12-foot converter on self-fluxing sulphide ore from the Mary, East Tennessee, and Isabella mines, at Isabella. The Mary and Isabella mines are opened by 1,200-foot vertical shafts, and the East Tennessee mine by a 700-foot shaft.

Most of the lead and zinc produced was obtained from the Embree mine, in Washington County, and the Mascot mine, in Jefferson County, as the mines of the Union Zinc Co. in Union County, the Tennessee Zinc Co. in Claiborne County, and the Grasselli Zinc Co. in Jefferson County, were idle in 1920.

The Embree Iron Co. operated the Embree mine, which yields zinc carbonate and lead carbonate ores. Part of the zinc ore is shipped directly from the mines, and part is concentrated by means of log washers and tables. The dried crude zinc ore and concentrates contained 40.33 per cent of zinc. One-fourth of the galena ore was shipped without treatment, but most of the crude ore was concen-

trated by means of jigs and tables into a product averaging about 62 per cent of lead.

The American Zinc Co. of Tennessee continued its steady operation of the Mascot mine, near Mascot, in Jefferson County, but the Roseberry mine had no production and was abandoned. The sulphide ore is hoisted from the Mascot mine through two shafts, one 300 feet deep and the other 800 feet deep. The concentrating plant is equipped for concentration by means of jigs, tables, and oil flotation, and has a capacity of 2,400 tons in 24 hours.

VIRGINIA.

The mines of the Bertha Mineral Co., at Austinville, and the Helen Mineral Co., at Ivanhoe, in Wythe County, and of the Atlantic Lead & Zinc Co., in Albemarle County, Va., were idle in 1919 and 1920, and no recoveries of gold and silver were reported from the smelting of pyritic ores. The value of gold produced from mines in Virginia during the period 1828 to 1918 was $3,296,569,[3] of which less than $13,000 has been recovered during the last 10 years. The deep and placer gold mines in Albemarle, Floyd, Fauquier, Goochland, and Fluvanna counties have yielded about half of the total in that period, the remainder of the gold being derived from cinders of pyritic ores or copper ores shipped to smelting plants.

[3] Director of the Mint Ann. Rept., 1919, p. 53.

MAGNESIUM.

By R. W. Stone.

PRODUCTION.

So far as has been learned by the United States Geological Survey only two companies in the United States produced magnesium in 1920—the American Magnesium Corporation, Niagara Falls, N. Y., and the Dow Chemical Co., Midland, Mich. For a number of years the American Magnesium Corporation has been the largest producer. Its output of metallic magnesium has been marketed in both stick and powdered form, and only a very small part has been sold as alloys and castings. This corporation has spent considerable time and money in developing the method of production and has been generous toward the public in the dissemination of information. The Dow Chemical Co. has produced magnesium in stick form only, and that in comparatively small quantity. Its production has been used largely in experimental work with various automobile and aircraft parts and in making pistons. Only a small part of its total output has been sold in the open market. Special permission is necessary for the Geological Survey to make public the production of less than three producers of a commodity, and that permission has not been granted. It may be stated, however, that the quantity and value of the metallic magnesium reported to the Geological Survey as produced in 1920 was only slightly less than in 1919.

Metallic magnesium produced in the United States, 1915–1920.

Year.	Number of producers.	Quantity (pounds)	Value.	Average price per pound.	
				Stick.	Powder.
1915	3	87,500	$440,000	$5.00	.....
1916	4	75,400	311,462	4.13	.....
1917	5	115,813	233,626	2.02	.....
1918	4	284,118	615,217	1.81	$2.67
1919	3	127,465	247,302	1.83	2.85
1920	2	(a)	(a)	1.60	2.75

a Permission to publish withheld.

The figures in this table represent the quantity of metallic magnesium manufactured each year. Sales have not been recorded, because in former years they have been almost equivalent to production, and to record sales would involve a record of stocks on hand

at the end of the year and of the quantity consumed by producers in experimental work. Metallic magnesium is stable under atmospheric conditions, and presumably all that is produced will eventually be sold or used. During the first eight months of 1920 the demand for metallic magnesium was good. By September, however, it seemed evident that magnesium could be imported from Germany at a lower price than the cost of production in this country, and domestic production on a commercial scale ceased. During the remainder of 1920 the manufacture of magnesium in this country was only that incident to research and experimental work. Metal withdrawn from stocks and imported from Germany satisfied the demand in the later part of the year. The stocks on hand December 31, 1920, amounted to about 75,000 pounds.

PRICE.

The American Metal Market quoted metallic magnesium at $1.60 to $1.85 a pound until late in September and at $1.60 to $1.75 during the last three months of 1920. These prices applied to metal in 100-pound lots f. o. b. factory. Sales were made on large contracts at lower figures than those quoted, and the average price per pound, as determined from actual sales during the year, was approximately $1.60. Magnesium powder is sold in sizes ranging from 60 to 200 mesh, and the fine material commands a higher price than the coarse. The best evidence available indicates that the average price of powder sold by the original producer was between $2.70 and $2.75 a pound.

The average price per pound for domestic magnesium in sticks was $5 in 1915, $4.13 in 1916, $2.02 in 1917, $1.81 in 1918, $1.83 in 1919, and $1.60 in 1920. Imported magnesium was quoted at $1.65 in 1913 but was not obtainable during the World War. The grade of magnesium known as "elektron," containing about 4 per cent of zinc, was obtainable in New York in December, 1920, at 60 cents a pound, duty paid, and imported magnesium in grades up to 99.9 per cent pure cost as much as 80 cents a pound, duty paid.

The average price per pound of domestic magnesium powder was approximately $2.67 in 1918, $2.85 in 1919, and $2.75 in 1920. The value declared for German magnesium powder was $1.20 a pound in 1914 and averaged $1.03 a pound in 1919.

IMPORTS.

The records of the Department of Commerce show the following imports of metallic magnesium:

Magnesium imported into the United States, 1918–20.

Year.	Quantity (pounds).	Value.	Value per pound.
1918—July to December	11,899	$16,259	$1.37
1919	13,239	13,583	1.02
1920	29,275	25,055	.85

The following statement of imports from Germany in 1914 has recently been published:

Magnesium imported from Germany in 1914.[a]

Form.	Quantity (pounds).	Value.	Value per pound.
Fused metal	35,817	$39,750	$1.11
Powder	931	1,116	1.20
Fine powder	34	92	2.70
Wire	6	18	3.00

[a] Dept. Commerce, Misc. Ser. 82, 1919.

The duty on magnesium and alloys of which magnesium is the component of chief value is 25 per cent ad valorem, according to paragraph 143 of the act of October 3, 1913.

EXPORTS.

In view of the fact that magnesium is manufactured and sold in Europe, the principal market, at a much lower price than in this country, there have been no exports since the war, so far as has been learned. There are no published statistics of exports of magnesium except the reports of producers that 50,000 to 60,000 pounds was sold to the Allies in 1918. The present situation does not suggest the probability or likelihood of there being a foreign market for American magnesium in the near future.

SOURCE.

Metallic magnesium may be derived from several nonmetallic minerals. It is produced in this country by the electrolysis of fused magnesium chloride at one plant and of fused magnesium oxide at the other plant.

The Dow Chemical Co. uses hydrous magnesium chloride for the manufacture of metallic magnesium. This chloride is a by-product from its salt and bromine industry in the Saginaw Valley, Mich. The hydrous magnesium chloride, mixed with common salt in the proportion of 4:1 and with a small quantity of ammonium chloride, is heated in shallow vats over a slow coal fire to remove its combined water. About 50 per cent of the water is driven off in this way. The partly dehydrated mixture is removed from the vats, cooled, and then completely dehydrated in a second furnace with higher temperature. The metal is then produced by electrolysis of fused magnesium chloride in a bath of NaCl and NH_4Cl. The electrodes used are graphitized carbon, and electrolysis takes place in cylindrical sheet-iron cells, which serve as cathodes.

The American Magnesium Corporation uses magnesite mined on the Pacific coast and calcined before shipment to the plant at Niagara Falls, N. Y., because calcination, which drives off the carbon dioxide, reduces the weight one-half. The firm produces magnesium by electrolysis of the fused oxide. The electrolyte or bath is a mixture of fused fluorides, the oxide going into solution and being decomposed by the electric current. The slag is removed and metal drawn from the furnaces at hourly periods and poured in small ingot molds. The metal is refined by remelting the ingots in small retorts.

USES.

Most of the magnesium now used is employed in foundries as a deoxidizer or scavenger in brass, bronze, copper, nickel, and aluminum. Magnesium was for a time used principally in the production of flares, tracer bullets, and special explosives. The use of magnesium powder as a flash light in photography is well known. The demand for magnesium for these purposes, however, is not large enough at present to keep the plants now developed in operation at full capacity. Magnesium is used in a small way in making alloys with other metals, and this use may eventually furnish a market for a considerably increased quantity, but in the United States this use is still largely experimental. The metal can also be made into sheets, rods, tubes, and castings, and it is in these forms or in alloys with other metals that it is likely to find its larger future use.

The physical characteristics and uses of magnesium are described in the report on magnesium in 1918 from Mineral Resources of the United States, copies of which are available for distribution.

PRESENT CONDITION OF THE INDUSTRY.

At the end of 1920 the manufacture of magnesium in the United States was practically suspended; the plants were not operating commercially but only for experimental purposes. This condition has continued to the present time (June, 1921) and is due to the importation of magnesium from Europe at a price which the domestic producers can not meet. The situation is described in Tariff Information Surveys on the articles in paragraph 143 of the tariff act of 1913, prepared by the United States Tariff Commission and printed for the use of Committee on Ways and Means, House of Representatives, 1921.

CHROMITE.

By Edward Sampson.

INTRODUCTION.

The only commercially valuable ore of chromium is chromite, whose composition is indicated by the formula $FeCr_2O_4$ or $FeO.Cr_2O_3$. Theoretically pure chromite would contain 68 per cent of chromic oxide (Cr_2O_3) and 32 per cent of ferrous oxide (FeO). In natural chromite some of the ferrous iron is usually replaced by magnesium and some of the chromium by aluminum and ferric iron, so that the natural mineral, free from admixtures of other minerals, seldom contains as much as 60 per cent of chromic oxide. As the chromite in commercial ore is mixed with other minerals the ore rarely contains more than 55 per cent of chromic oxide, and most of the ore now marketed contains about 50 per cent. A full discussion of the composition of the mineral chromite and of the bearing of the composition on the value of the ore may be found in other publications of the Geological Survey, notably in the papers of Knopf and Lewis.[1] Chromite is always associated with basic intrusive igneous rocks or their alteration products, especially serpentine.

USES.

Chromium has many uses, but it is most largely used as a constituent of chrome steel, a steel made to resist great wear and violent stresses, such as those imposed upon armor plate, automobile springs, ball bearings, and jaws of rock crushers. The chromium is introduced into the steel as ferrochrome containing usually between 60 and 70 per cent of chromium.

A corrosion-resisting chrome steel known as "stainless steel," though first made long ago, has recently received considerable attention and may become of wide application. The properties of this steel are described by J. H. G. Monypenny.[2] As commonly made it contains from 11 to 14 per cent of chromium and not more than 0.45 per cent of carbon. It strongly resists rusting and all forms of oxidation, even at high temperatures, and it is not corroded by many agents that attack ordinary steel, nor is it affected by nitric acid, though it is attacked by hydrochloric or sulphuric acid. Salt water, fruit juices, and ammonia have no effect on it, whence the name "stainless." Although invented by an American, "stainless steel" was first used in England for making cutlery steel, but it may be used for other purposes. During the World War it was used extensively for making the valves of internal-combustion engines, a use for which it is particularly suited, not only because it resists pitting but also because it retains its strength at high temperatures to a marked degree. Monypenny states that stainless steel is subject to as great

[1] Knopf, E. B., and Lewis, J. V., Chrome ores in Pennsylvania, Maryland, and North Carolina; U. S. Geol. Survey Bull. 725, pp. 85–139, 1921 (Bull. 725–B).

[2] Monypenny, J. H. G., Stainless steel: Soc. Chem. Ind. Jour., vol. 39, No. 22, pp. 390R–391R, 1920; abstract and editorial comment, Min. and Sci. Press, vol. 122, No. 14, April 2, 1921.

a variety of heat treatment as ordinary steel and that its physical properties are equal to those of ordinary steel and in some respects superior. The war delayed the development of stainless steel because of the lack of chromite, but its use should increase greatly, and it may even be used in structural work.

Stellite is essentially an alloy of cobalt and chromium, to which is usually added a small quantity of tungsten to increase its strength. Its composition varies as follows:[3] Cobalt, 50 to 60 per cent; chromium 30 to 40 per cent; tungsten, 8 to 20 per cent. It strongly resists corrosion and is of great hardness. Its hardness persists at high temperatures, so that during the war it was largely used in high-speed lathe tools employed for turning shell and ordnance. It is extensively used in the manufacture of surgical and dental instruments.

Chromite is used as a refractory material, principally in the steel industry. In fact, one of the chief objections to chromite is that it is so refractory that it will not sinter or form a bond, so that it is subject to considerable mechanical wear. About 60 per cent of the chromite used as a refractory is in the form of brick and the remaining 40 per cent is in the form of lump and crushed ore. It is used chiefly in the basic open-hearth process, by which three-quarters of the steel produced in the United States is made. Chrome brick are used between the clay-brick or silica-brick foundation and the magnesite floor and also as a neutral band between the basic lower and acid upper walls. The crushed ore is extensively used for making repairs and to some extent for protecting the acid roof. It has been estimated that about 1½ pounds of chromite are consumed for each ton of steel made. Small quantities of chromite refractories are used in certain parts of furnaces for smelting copper and nickel.

The chemical industry consumes a large quantity of chromite in making chromates and bichromates of soda and potash and chromic acid. Before the war the tanning industry consumed about two-thirds of the chromium chemicals, but during the war the proportion was reduced to about one-half. In dyeing textiles chromium salts are used as mordants. The cloth is saturated with the mordant and then introduced into a bath of the coloring matter where a precipitate (lake) is formed on and in the fiber of the cloth. Chromium compounds are also used as pigments.

Early in 1918 the War Industries Board, after a canvass of the consumers, made an estimate of the quantities of chromite that would be required in 1918 by the different domestic industries. The total estimated requirement was 130,000 tons of 50 per cent ore, which, reduced to percentages by uses, amounted to the following figures: For ferrochrome 52 per cent, for chemicals 31 per cent, for refractories 17 per cent. These figures, however, are only approximate and would not apply to a normal year, but they show the order of magnitude of the requirements of the several industries.

PRODUCTION.

A review of the chromite industry for 1920 shows that in many respects prewar conditions have been reestablished, though production shows some marked and probably permanent effects of the war.

[3] Wright, S. B., Stellite: Canadian Min. Inst. Trans., vol. 21, pp. 272–277, 1918.

In 1918, 82,430 long tons of chromite was sold, a greater annual output than was ever before recorded by any country. In addition to the ore sold 42,687 tons remained in stock in the hands of 335 producers. In 1919 there were only 39 shippers, who shipped 5,079 tons, 1,300 tons of which came from the most accessible and best of the 1918 stock. Inclusive of additions to stock from ore mined in 1919, there was at the end of that year about 41,500 long tons of ore still in the hands of about 330 different owners. Mining carried on during 1920 had a negligible effect on this large stock of ore, and therefore these figures are believed to be essentially accurate for the end of 1920. The average stock of individual owners is therefore 126 tons. Moreover the stock is very widely scattered, and much of it is at points remote from railroads and at mines now abandoned. Only prices approaching those that prevailed during 1918, when domestic ore sold for three times its present price, are likely to bring an appreciable quantity of this ore on the market.

In 1920 there was sold 2,502 long tons of ore, nearly all of which was mined during the year. For comparison the figures of the shipments of chromite from 1913 to 1920 are given in the table on page 26.

Only 19 mines shipped ore in 1920, as compared with 39 in 1919. Of these 19 mines, 17 are in California, 1 is in Oregon, and 1 is in Wyoming. Although California still led in production in 1920, her lead was reduced from 64 to 57 per cent of the total. The proportion of the total furnished by Oregon increased from 11 to 38 per cent, but that furnished by Wyoming decreased from 24 to 5 per cent. A small quantity of ore was mined in Montana and in Maryland, but none was shipped from either of these States.

Crude chromite mined and shipped from mines in the United States in 1920, by States.

[Quantities in long tons.]

State.	Number of shippers, all grades.	Ore containing 45 per cent or more of chromic oxide.			Ore containing 35 to 45 per cent of chromic oxide.		
		Quantity mined.	Quantity shipped.	Average value per ton.	Quantity mined.	Quantity shipped.	Average value per ton.
California	17	1,489	1,143	$26.05	154	228	$14.98
Maryland	.....	4	.....	.....	5	.....	.....
Montana	.....	.....	.....	.....	89	.....	.....
Oregon	1	3	.....	.....	1,089	955	7.84
Wyoming	1	.....	.....	.....	131	131	28.12
	19	1,496	1,143	26.05	1,468	1,314	11.10

State.	Ore containing 35 per cent or less of chromic oxide.			Total.			
	Quantity mined.	Quantity shipped.	Average value per ton.	Quantity mined.	Quantity shipped.	Value.	Average value per ton.
California	116	45	$11.11	1,759	1,416	$33,687	$23.79
Maryland	.....	.....	.....	9	.....	.....	.....
Montana	22	.....	.....	111	.....	.....	.....
Oregon	.....	.....	.....	1,092	955	7,486	7.84
Wyoming	.....	.....	.....	131	131	3,684	28.12
	138	45	11.11	3,102	2,502	44,857	17.93

PRODUCERS.

The following is a list of those who mined or shipped chromite during 1920:

California:
- Young Adams, Middletown.
- S. Aumaier, San Luis Obispo.
- Arthur L. Coggins, Dunsmuir.
- P. S. Dean, Felix.
- E. DeKruse, Iowa Hill.
- J. E. Esper & S. Lovejoy, Auburn.
- J. Albert Ferbrache, Route A, Box 42, Gilroy.
- Bart Finning, Foresthill.
- H. L. Flournoy, Morro.
- G. R. Grassely, Chinese Camp.
- Walter R. Harris, Bryson.
- Henry and August Hermann, Middletown.
- Lee Jackson, Brandy City.
- N. Lambert, Fort Jones.
- J. F. McGinnis, Monticello.
- George Madeira, sr., 1550 Page Street, San Francisco.
- Phillips & Lowden, Seiad Valley.
- Walter W. Pierce, Morro.
- Placer Chrome Co., Wm. P. Netherton, Santa Cruz.
- R. J. Pollock, Yankee Hill.
- Powell & Turnbull, E. J. Powell, Foresthill.
- G. A. Reichman & George Milne, Fort Jones.
- A. C. Scales, 2205 Sacramento Street, San Francisco.
- Willis A. Sharp, Grants Pass, Oreg.
- William Shules, Hayfork.
- G. Simon, 3319 J Street, Sacramento.
- D. J. Sullivan, Auburn.

Maryland:
- Chrome Mining Co., Lee W. Squier, secretary, Finance Building, Philadelphia, Pa.

Montana:
- T. C. Benbow, Columbus.
- M. Mouat, Nye.

Oregon:
- Alma Davis, Prairie City.
- Everett Fry, Logdell.
- F. W. Peet, Blue Mountain Chrome Co., Prairie City.

Wyoming:
- Ferro Alloy Co., 603 Symes Building, Denver, Colo.

IMPORTS.

CHROMITE.

More chromite was imported into the United States in 1920 than in any preceding year. The quantity and value of the ore imported from each country since 1913 are shown in the table on page 25. In this table the ore is credited to the country from which it was shipped or to the country from which it was transshipped. Thus the ore listed under British and Portuguese South Africa should be credited to Rhodesia. The ore listed under French Oceania and most of that listed under Australia should be credited to New Caledonia. Outstanding features of the table are the large quantities of ore imported in 1920, as compared with previous years, from Rhodesia, New Caledonia, Turkey, and Greece. These are the countries which supplied almost the entire market before the war. Much of this ore was mined during the war but was not shipped for lack of bottoms. The

values of the ore originating in Rhodesia, New Caledonia, and Turkey are worthy of particular note. The average value, in the country from which the ore was shipped, of all chromite imported since 1913 is as follows: 1913, $9.56; 1914, $8.77; 1915, $10.20; 1916, $13.35; 1917, $15.41; 1918, $28.89; 1919, $22.50; 1920, $12.79.

Crude chromite imported into the United States, 1913–1920, in long tons.[a]

Country.	1913	1914	1915	1916	1917	1918	1919	1920		
								Quantity.	Value.	Average value per ton.
Australia	.....	.....	.....	2,986	.....	15,976	13,161	2,778	$94,317	$33.95
Belgium	.....	.....	.....	.....	.....	.....	.....	239	8,486	35.51
Brazil	.....	.....	.....	.....	.....	17,854	4,800	3,451	73,720	21.36
British South Africa	.....	.....	22,800	23,000	4,750	521	29	39,400	268,440	6.81
Canada	.....	533	10,087	12,220	19,012	20,949	8,941	8,491	169,805	20.00
Cuba	.....	.....	.....	34	17	8,821	14,461	710	20,397	28.73
England	.....	58	2	5	5	4	.....	3,799	115,733	30.46
French Oceania [b]	21,850	30,860	28,031	30,950	10,300	25,761	7,125	[b] 50,314	[b] 452,217	8.99
Germany	.....	.....	.....	.....	.....	.....	.....	1	83	83.00
Greece	4,600	8,155	4,305	7,900	.....	.....	.....	5,302	144,502	27.25
Guatemala	.....	.....	.....	.....	179	1,193	1,659	1,122	68,960	61.46
India	.....	.....	.....	.....	.....	.....	.....	4,500	75,021	16.67
Japan	79	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Zealand	.....	.....	.....	.....	.....	.....	693	.....	.....	.....
Other British Oceania	.....	.....	.....	.....	.....	1,063	.....	.....	.....	.....
Peru [b]	.....	.....	.....	.....	.....	.....	.....	[b] 6,368	[b] 159,200	25.00
Portuguese Africa	30,001	23,200	11,230	38,850	37,800	8,000	4,000	11,000	43,670	3.97
Spain	.....	.....	.....	.....	.....	.....	3,035	40	1,250	31.25
Turkey in Asia	8,650	11,880	.....	.....	.....	.....	3,500	12,760	226,023	17.71
	65,180	74,686	76,455	115,945	72,063	100,142	61,404	150,275	1,921,824	12.79

[a] Statistics compiled by J. A. Dorsey, of the Geological Survey, from records of Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.

[b] The Bureau of Foreign and Domestic Commerce reports that the ore listed under Peru should be credited to French Oceania.

For further comparison it may be noted that the ore to be credited to the chief producing countries was valued at the ports of shipment as follows in the fiscal year 1913 and the calendar year 1920: New Caledonia, 1913, $7.24; 1920, $8.99;[4] Rhodesia, 1913, $12.17; 1920, $6.19.[5] The explanation of the large imports in 1920 is then to be found in the attractive price of the foreign ore. It is reported that the leading consumers have laid in heavy stocks.

[4] Includes only ore listed under French Oceania in table; does not include ore listed under Australia because of freight charges added to value of transshipped ore.

[5] Average of ore listed under British South Africa and Portuguese Africa.

CHROMIUM COMPOUNDS.

The imports of chromium compounds are small as compared with the consumption.

Chromium compounds imported for consumption in the United States, 1913–1920.[a]

Year.	Chromic acid.			Chromate and bichromate of potash.			Chromate and bichromate of soda.			Chrome or chromium and ferrochromium.		
	Quantity (pounds).	Value.	Value per pound.	Quantity (pounds).	Value.	Value per pound.	Quantity (pounds).	Value.	Value per pound.	Quantity (long tons).	Value.	Value per ton.
1913	5,562	$1,100	$0.20	18,629	$1,819	$0.10	.....	.....	.....	307	$51,415	$167
1914	9,164	1,597	.17	31,858	2,375	.07	11,056	$542	$0.05	200	21,553	108
1915	3,571	755	.21	32,942	2,902	.09	.....	.....	.....	32	1,662	52
1916	.....	.....	.....	459	75	.16	6,154	3,630	.59	10	1,998	200
1917	.....	.....	.....	2,402	962	.40	22,025	4,075	.19	.....	.....	.....
1918	9,512	1,857	.19	20	8	.40	5,102	1,184	.23	.....	.....	.....
1919	.....	.....	.....	15,450	4,271	.28	.....	.....	.....	414	100,404	243
1920	1,100	90	.08	4,414	2,690	.61	.....	.....	.....	1,751	428,619	245

[a] From records of the Bureau of Foreign and Domestic Commerce.

CONSUMPTION.

The apparent available supply from 1913 to 1920 is shown in the accompanying table. The Geological Survey has no record of the quantity of ore carried in stock by the consumers, but it is thought that from 1913 to 1919 there were no large accumulated stocks. Therefore the figures for the apparent available supply (domestic shipments plus imports) are probably nearly the same as those of actual consumption. There are no records of exports of chromite. During 1920 large stocks of ore were laid in as a result of the low prices of imported ore. Much of the ore was sold at prices which, in the country of origin, were considerably lower than those prevailing in 1913, even when the difference in the rate of exchange is taken into account.

Domestic sales, imports, and apparent consumption of chromite in the United States, 1913–1920.

Year.	Domestic sales.			Imports.			Apparent available supply.		
	Quantity (long tons).	Value.	Value per ton.	Quantity (long tons).	Value.	Value per ton.	Quantity (long tons).	Value.	Value per ton.
1913	255	$2,854	$11.19	65,180	$622,821	$9.56	65,435	$625,675	$9.56
1914	591	8,715	14.75	74,686	655,306	8.77	75,277	664,021	8.82
1915	3,281	36,744	11.20	76,455	780,061	10.20	79,736	816,805	10.24
1916	47,035	726,243	15.44	115,945	1,548,402	13.35	162,980	2,274,645	13.96
1917	43,725	1,049,400	24.00	72,063	1,110,659	15.41	115,788	2,160,059	18.66
1918	82,430	3,955,567	47.99	100,142	2,892,825	28.89	182,572	6,848,392	37.51
1919	5,079	129,302	25.46	61,404	1,381,497	22.50	66,483	1,510,799	22.72
1920	2,502	44,857	17.93	150,275	1,921,824	12.79	152,777	1,966,681	12.87

PRICES.

Chromite is sold in the United States on the basis of the long-ton unit of chromic oxide (Cr_2O_3), the unit being 1 per cent. In foreign countries it is generally sold on the basis of the long or metric ton. During the war, when chromite was in such great demand, ore of very low grade was marketable. At that time the unit price varied according to the grade of the ore. For example, in the summer of 1918 the price of 30 per cent ore was $0.85 per unit ($25.50 per long ton) and the price of 48 per cent ore was $1.50 per unit ($72 per long ton). Intermediate grades sold at intermediate prices. Through the first part of 1920 ships were scarce, and the price of chromite rose accordingly. Toward the end of the year chromite was imported in large quantity, and the price fell to about half of the price at the beginning of the year.

The market quotations that follow are taken from the Engineering and Mining Journal. In January, 1920, imported ore was quoted at $0.75 per unit. By April the price had risen to $0.70–$1.25 for 48 per cent ore and $0.60–$0.85 for 35 to 40 per cent ore, and the market was reported as firm at these prices. By the middle of May guaranteed 50 per cent imported ore with a maximum of 6 per cent of silica was quoted at $0.72–$0.80 at New York, and 50 per cent concentrates at $0.60–$0.65 in California. These prices held until the end of June, when the price of imported ore rose to $0.80–$0.85, with California ore unchanged. By the beginning of September California 50 per cent concentrates had also risen and were quoted at $0.70–$0.75. In the middle of November imported chromite fell to $0.60–$0.75, and by the end of November to $0.60–$0.65. Throughout December imported ore was quoted at $0.55–$0.60 and California concentrates at $0.60–$0.65.

There has been a gradual fall in prices in 1921. At the end of May imported guaranteed 50 per cent ore with less than 6 per cent of silica was quoted at $0.45–$0.50 per unit, which is equivalent to $22.50–$25 per long ton. California ore has ceased to enter the eastern market, as at the present freight rates it can not compete with the imported ore.

WORLD'S PRODUCTION.

The deposits and production of chromite in foreign countries were considered at length in the chapter on chromite in Mineral Resources for 1918. During 1920 and 1921 the section of foreign mineral reserves of the United States Geological Survey has been obtaining statistics as to the output of minerals in foreign countries, and it is now possible to publish a more complete table of world's production than those heretofore given. The figures are taken from the most reliable sources available, but differ in degree of accuracy, as independent official publications may give different figures. The references will enable an opinion to be formed as to the value of the figures. A few of the figures in the table are the writer's estimates.

Crude chromite produced by different countries, 1913–1920, in metric tons.

Country.	1913	1914	1915	1916	1917	1918	1919		1920	
							Quantity.	Percentage of total.	Quantity.	Percentage of estimated total.
Austria-Hungary [a]	305	533	(b)	(b)	12,600	(b)	(b)	.....	(b)	.....
Australia [c]	688	659	769	621	1,142	611	254	.....	(b)	.....
Brazil [d]	.....	.....	.....	.....	.....	18,141	4,877	4	3,451	2
Canada [e]	.....	123	11,196	24,963	33,317	19,952	8,678	6	9,525	5
Cuba [f]	.....	.....	.....	35	17	8,963	14,693	11	710	.....
Great Britain [g]	113	119	.....	392	303	142	152	.....	(b)	.....
Greece [h]	6,930	9,380	7,520	10,447	9,600	2,640	4,164	3	(b)	.....
Guatemala [i]	.....	.....	.....	.....	182	1,212	1,686	1	1,122	1
India [i]	5,767	5,982	3,828	20,484	27,495	58,697	37,024	27	(b)	.....
Japan [j]	1,326	2,116	2,989	8,278	8,941	6,247	6,012	4	(b)	.....
New Caledonia [k]	63,370	71,708	57,474	74,715	41,892	26,000	20,000	14	60,000	32
Norway [l]	.....	81	350	2,757	3,975	(b)	(b)	.....	(b)	.....
Rhodesia [m]	57,500	43,732	54,958	80,622	66,190	28,382	32,007	23	54,674	29
Russia [n]	15,000	15,000	15,000	15,000	(b)	.....	.....	.....	.....	.....
Turkey (Asia Minor) [p]	14,000	14,000	14,000	14,000	(b)	(b)	3,500	3	25,000	13
United States	259	600	3,334	47,790	44,427	83,753	5,161	4	2,542	1
	165,258	164,033	171,418	300,104	250,081	254,740	138,208	100	[q]190,000	.....

[a] 1913: U. S. Geol. Survey Mineral Resources, 1918, pt. 1, p. 678, 1917; Min. Jour., London, Dec. 18, 1920. (Production for Hungary.)
[b] Figures not yet available.
[c] New South Wales Dept. Mines Ann. Repts. Queensland Undersecretary for mines. Ann. Repts.
[d] 1918–1920: Imports into United States Bur. Foreign and Domestic Commerce.
[e] Canada Dept. Mines, Mines Branch. 1913–1919, Ann. Repts. 1920, Prelim. Report.
[f] Imports into United States, Bur. Foreign and Domestic Commerce.
[g] Great Britain, Mines and Quarries, General Reports, pt. 3.
[h] 1913–1917: Tableaux statistiques du mouvement minier de la Grèce, 1918–19; Information from United States consulate general, Athens, Greece, Aug. 31, 1920.
[i] 1913–1918: India Geol. Survey Records, 1919; Preliminary statement by director India Geol. Survey.
[j] 1913–1917: Résumé statistique de l'empire du Japon, 1918–19; Mining Industry, Japan Dept. Commerce, Bur. Mines.
[k] 1913: Statistique de l'industrie minière dans les colonies francaises, 1915–1918; Mineral Industry, 1919. Figures except for 1915 are for exports, 1919–20; estimates this report.
[l] Norges Bergverksdrift.
[m] 1913–1919: Report of Secretary for Mines, Rhodesia, 1920; Mining Journal, London, Jan. 27, 1921.
[n] Estimates, 1913–1916, U. S. Geol. Survey Mineral Resources, 1918, pt. 1, p. 678.1918–20: This report.
[p] Estimates, 1913–1916, U. S. Geol. Survey Mineral Resources, 1918, pt. 1, p. 678. 1919: This report. 1920: This report, on basis, largely, of information furnished by E. J. Lavino & Co., importers.
[q] Estimate.

BAUXITE AND ALUMINUM.

By James M. Hill.

BAUXITE.

DOMESTIC PRODUCTION AND CONSUMPTION.

The domestic bauxite mined and marketed in 1920 showed an increase of 38 per cent in quantity and nearly 48 per cent in value as compared with the production in 1919. The production of the fields in Georgia, Alabama, and Tennessee decreased 7 per cent as compared with 1919, but the Arkansas field increased its production 44 per cent.

Of the domestic bauxite marketed in 1920 producers of aluminum took 383,154 tons, makers of chemicals 85,878 tons, and makers of abrasives 52,276 tons.

Bauxite produced and consumed in the United States, 1916–1920.

Year.	Domestic production.					
	Georgia, Alabama, and Tennessee.		Arkansas.		Total.	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1916	49,190	$284,810	375,910	$2,011,590	425,100	$2,296,400
1917	62,134	395,051	506,556	2,724,007	568,690	3,119,058
1918	42,829	314,112	562,892	3,133,880	605,721	3,447,992
1919	43,076	346,588	333,490	1,855,159	376,566	2,201,747
1920	40,029	349,453	481,279	2,897,892	521,308	3,247,345

Year.	Imports.		Exports.[a]		Apparent domestic consumption.	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1916	30	$87	17,939	$987,454	407,191	$1,309,033
1917	7,691	28,989	21,791	1,323,926	554,590	1,824,121
1918	3,653	14,791	19,711	1,523,688	589,663	1,939,095
1919	6,082	36,820	17,701	1,372,094	364,947	866,473
1920	42,895	251,284	22,257	1,843,596	541,946	1,655,033

[a] Includes bauxite concentrates.

The apparent consumption of bauxite in 1920, as shown by the table above, increased 48 per cent as compared with the consumption in 1919. These figures are not strictly true, as the exports are in large

part bauxite concentrates, so that the actual quantity of bauxite represented by the exported materials should be several times larger than the figure given; but information is not available upon which to estimate the exact quantity of bauxite represented; hence the figures are given as reported by the Department of Commerce.

The quantity of domestic bauxite consumed in 1920 by the aluminum industry was 41 per cent greater than in 1919, by the chemical industry 27 per cent, and by the abrasive industry 48 per cent.

Domestic bauxite consumed by various industries, 1916–1920, in long tons.

Industry.	1916	1917	1918	1919	1920
Aluminum	300,000	375,000	419,043	272,270	383,154
Chemical	80,000	82,000	63,896	67,842	85,878
Abrasive	45,000	110,000	112,908	35,395	[a] 52,276
Refractory		2,400	9,874	1,059	.....

[a] Probably includes a small quantity sold to makers of refractories.

MARKET AND PRICES.

The market for bauxite continues to be east of Mississippi River. Each year there are added a few new plants using the Hoover or some similar process at municipal or industrial waterworks, which buy bauxite and make an impure aluminum sulphate that has proved an entirely satisfactory coagulant for water purification.

In 1920 there were almost no producers of bauxite that were not also consumers. The average price for the 1920 output, $6.23 a ton reported by producers, is therefore not the price that would have been asked for small lots of bauxite in the open market. The prices reported by producers ranged from $5.75 to $10.85 a ton. Supplies of bauxite were somewhat short during the first half of the year, but conditions improved during the closing months. It is believed that the supplies of bauxite for 1921 should be adequate for all demands, though the closing of the mines in British Guiana may cause a slight shortage in the early months. It is believed that the domestic deposits are capable of supplying all domestic demands.

A complete list of all those known to the United States Geological Survey to be users of bauxite follows:

Aluminum Co. of America, Pittsburgh, Pa.
Booth Chemical Co., P. O. Box 203, Elizabeth, N. J.
Carborundum Co., Niagara Falls, N. Y.
Charles Lennig & Co. (Inc.), 112 South Front Street, Philadelphia, Pa.
Charles Taylor Sons Co., Cincinnati, Ohio.
Columbus Waterworks, R. D. 5, Columbus, Ohio.
Como Chemical Co., Kokomo, Ind.
Cumberland Waterworks, R. D. 3, Cumberland, Md.
Detroit Chemical Works, 238 Junction Avenue, Detroit, Mich.
Detroit Waterworks, Detroit, Mich.
E. I. du Pont de Nemours Powder Co., Wilmington, Del.
Erie Chemical Works, 31 Union Square West, New York, N. Y.
Exolon Co., 156 Sixth Street, Cambridge, Mass.
General Abrasives Co., Niagara Falls, N. Y.
General Chemical Co., 25 Broad Street, New York, N. Y.
General Refractories Co., Trinity Building, New York, N. Y.
Gulf Refining Co., Pittsburgh, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.

International Abrasive Corporation, 5 Dorchester Avenue Extended, Boston, Mass.
Jarecki Chemical Co., St. Bernard Station, Cincinnati, Ohio.
Kalbfleisch Corporation, Chattanooga, Tenn.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Massillon Stone & Fire Brick Co., Massillon, Ohio.
Merrimac Chemical Co., 33 Broad Street, Boston, Mass.
Metropolitan Water District of Omaha, Omaha, Nebr.
Montclair Water Co., Paterson, N. J.
Norton Co., Worcester, Mass. (also Niagara Falls, N. Y.).
Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
Springfield Waterworks, Springfield, Mass.
Superior Chemical Co., Joliet, Ill.
Trenton Waterworks, Trenton, N. J.
Welch Chemical Co., 8 East Long Street, Columbus, Ohio.

In 1920 bauxite was produced by the companies listed below. It is not known whether all of these producers are in position to sell bauxite, but any of them might have some surplus which could enter the general market.

American Bauxite Co., 1111 Harrison Building, Philadelphia, Pa.
E. I. du Pont de Nemours Powder Co., Wilmington, Del.
Globe Bauxite Co., Joliet, Ill.
Kalbfleisch Corporation, 31 Union Square West, New York, N. Y.
Mineral Products Corporation, 2234 Dime Savings Bank Building, Detroit, Mich.
Norton Co., Worcester, Mass.
Republic Mining & Manufacturing Co., 1111 Harrison Building, Philadelphia, Pa.
Warner Mining Co., Adairsville, Ga.

WORLD'S PRODUCTION.

No official statistics of the French output during the World War have been given, nor is it known definitely how much bauxite was mined from the deposits in former Austria-Hungary. It is reported [1] that the bauxite deposits in Istria and Dalmatia, which were operated by the Austro-Hungarian Government during the war, produced 60,925 metric tons in 1915, 142,326 tons in 1916, 163,122 tons in 1917, and probably a larger quantity in the first 10 months of 1918 than was produced in 1917. This bauxite was mined under military supervision and shipped to Germany. The article states that material carrying 44 per cent alumina was considered first quality ore.

World's production of bauxite, 1913 and 1916–1920, by countries, in metric tons.

Country.	1913	1916	1917	1918	1919	1920
Austria (Dalmatia and Istria)	(a)	b 142,326	b 163,122	b 155,000	(a)	(c)
British Guiana			2,070	4,266	2,008	b 27,872
British India	1,203	762	1,385	1,211	1,709	(a)
France	309,294	b 106,170	b 120,883	(a)	159,103	b 186,693
Hungary	(a)	(a)	16,213	(a)	(a)	(a)
Italy	6,952	8,887	7,789	7,800	2,972	b c 37,960
Spain				460	1,780	(a)
United Kingdom	6,152	10,495	14,960	9,743	9,369	11,197
United States	213,615	431,923	577,817	615,443	382,610	529,675

a Figures not yet available.
b Unofficial.
c Production of Dalmatia and Istria (33,860 tons) included under Italy.

[1] The Adriatic bauxite deposits: Min. Jour. (London), vol. 132, p. 137, Feb. 19, 1921.

BAUXITE DEPOSITS.

DOMESTIC.

ALABAMA.

The only bauxite produced in Alabama in 1920 came from the deposits near Rock Run, operated by the Republic Mining & Manufacturing Co.

ARKANSAS

The American Bauxite Co., operating in the vicinity of Bauxite 40 miles southwest of Little Rock, Ark., has greatly expanded its operations. Very large deposits of bauxite have been opened up for handling by steam shovel and additional areas of bauxite have been shown by drilling. During 1920 the company had a dozen steam shovels at work, some stripping the overburden of sandy clay from the bauxite and others digging bauxite. The ore is hauled by locomotives to the drying plant at the town of Bauxite, where the various grades are either dried or calcined before shipment. Early in the year it was estimated that about 10 cars of dried or calcined bauxite was being shipped daily. The Republic Mining & Manufacturing Co. has opened a new bauxite deposit near the Soldiers' Home a few miles east of Little Rock, and the E. I. du Pont de Nemours Powder Co. and the Globe Bauxite Co. are still working their mines in the same district.

GEORGIA.

In 1920 several of the older bauxite mines in Georgia were not in operation, but some new mines near Springvale, Randolph County, were opened. The largest producer in the State was the Republic mine, east of Andersonville, in Sumter County. The mines of Wilkinson County were second, Floyd County third, Randolph County fourth, Meriwether County fifth, Macon County sixth, and Bartow County seventh. The total production of the State in 1920 was 34,397 tons, all of which was used for the manufacture of chemicals.

TENNESSEE.

Only one mine in Tennessee reported production of bauxite in 1920. This mine operated by the Kalbfleisch Corporation, is near East Chattanooga, in Hamilton County.

FOREIGN.

GUIANA.

British Guiana.—During 1920 the Demerara Bauxite Co. operated its mines and drying plant at Mackenzie, British Guiana, and shipped 29,399 tons of calcined bauxite to the United States. The whole operation was suspended in January, 1921,[2] for an indefinite period. The British Government has not yet promulgated regulations for prospecting for and mining bauxite in the colony, so development by any other interests has been hindered.

Dutch Guiana.—The Dutch have made provision, under the law of March 27, 1919, as amended November 24, 1919,[3] for the holding and

[2] Eng. and Min. Jour., vol. 111, p. 363, Feb. 19, 1921.
[3] Commerce Repts., July 9, 1920, p. 170.

operation of bauxite lands in Dutch Guiana. Only inhabitants of the Netherlands or Surinam or companies established in either place are permitted to hold or operate concessions.

ITALY.

The Società anonima per l'escavo e l'industria di minerale d' aluminio was formed at Fiume in 1920 for the exploitation of bauxite deposits. The capital, stated to be 2,000,000 lire, is held by Italian and Hungarian groups. The latter group is said to have extensive bauxite holdings in the Bihar Mountains. According to recent information[4] 6,000 metric tons of bauxite was produced in 1920 from the Venezia Giulia Province, acquired by Italy at the close of the war, and 27,860 tons from the occupied zone of Dalmatia.

FRANCE.

The French bauxite mines have apparently been producing at the rate of approximately 14,000 metric tons a month during 1920. The total production for the year 1919 was 159,103 metric tons.[5]

ALUMINUM.

DOMESTIC PRODUCTION AND CONSUMPTION.

The value of primary aluminum produced in the United States in 1920 was about 7 per cent greater than in 1919 and a little greater than in 1918.

Value of aluminum produced and consumed in the United States, 1916–1920.

Year.	Domestic production.		Imports.[b]	Exports.[c]	Apparent consumption.
	Primary metal.	Secondary metal.[a]			
1916	$33,900,000	$23,430,200	$1,785,870	$15,417,134	$43,698,936
1917	45,882,000	16,711,800	56,890	14,586,467	48,064,223
1918	41,159,000	10,113,600	554,586	10,869,388	40,957,798
1919	38,558,000	12,014,600	4,568,595	3,890,326	51,250,869
1920	41,375,000	9,489,100	13,077,022	5,630,781	58,310,341

[a] Value of primary metal based on average open market price, as quoted by the Engineering and Mining Journal, and that of secondary aluminum based on average price as given by American Metal Market.
[b] Imports for consumption compiled by J. A. Dorsey, of the U. S. Geological Survey, from the records of the Department of Commerce, include aluminum in crude form, scrap, bars, strips, rods, plates, sheets, and all manufactures of.
[c] Exports include ingots, metal and alloy, plates and sheets, and all other manufactures of.

The figure for apparent consumption takes no account of stocks either at the beginning or the end of the year. It is understood that the producer of primary aluminum endeavors to maintain rather large stocks, but those held by producers of secondary aluminum are not known.

[4] Advance notice issued by the Ministero di Agricoltura, Rome, Italy, 1921.
[5] Statistique de l'industrie minérale et des appareils à vapeur en France et en Algérie, 1913–1919.

MARKET AND PRICES.

Apparently the market was well supplied with both primary and secondary aluminum throughout the year. Secondary aluminum was selling near the end of the year at prices considerably below those for equivalent primary grades. The price for 98–99 per cent primary metal in the open market, as will be seen from the table below, has been at approximately the same level throughout the year. The lowest price of the year was at its end, when quotations for primary metal reached 28.3 cents a pound. Secondary aluminum sold at 1 to 3 cents a pound less than the primary until December, when a difference of as much as 10 cents a pound was recorded.

Open-market prices of aluminum, 1915–1920, in cents per pound.[a]

Month.	1915	1916	1917	1918	1919	1920
January	19.08	55.00	59.20	37.10	32.33	33.26
February	19.22	58.00	58.30	37.00	31.25	33.45
March	19.00	60.25	59.20	32.00	31.00	32.91
April	18.88	59.50	60.00	32.00	30.00	32.74
May	22.03	59.00	60.00	32.00	33.00	33.00
June	30.00	61.50	60.00	33.00	33.00	33.00
July	32.38	60.20	56.10	33.00	33.00	33.00
August	34.50	60.00	49.00	33.00	33.00	34.00
September	47.75	61.88	43.20	33.00	33.00	34.85
October	50.00	65.05	39.30	33.00	33.00	33.50
November	57.75	65.12	36.70	33.00	33.00	32.90
December	57.13	63.00	37.00	33.00	33.00	32.00

[a] Quotations from Eng. and Min. Jour., vols. 109, 110, 1920.

ALUMINUM INDUSTRY.

The expansion of plant capacity in the United States has been continued as the development of hydroelectric power near Maryville, Tenn., and Badin, N. C., has increased the power available. Experiments of the Anaconda Copper Co.,[6] which have been under way for some time at Great Falls, Mont., resulted in the production of aluminum early in 1921, though not on a commercial basis as yet.

It is reported that a San Francisco company has under contemplation the development of an extensive water power on Klamath River which is to be used for the manufacture of aluminum.

The French aluminum industry has been brought into closer control by the purchase of the Société électrométallurgique française by the Compagnie d'Alais. The combination, which has a capital of 130,000,000 francs,[7] will control 90 per cent of the French aluminum-producing capacity and has extensive holdings in the Italian and Norwegian aluminum plants. Information is now available concerning the production of aluminum in France for the war period. The official figures[8] are as follows:

Aluminum produced in France, 1913–1919, in metric tons.

1913	13,483	1917	11,064
1914	9,963	1918	12,019
1915	6,017	1919	10,255
1916	9,601		

[6] Eng. and Min. Jour., vol. 111, p. 117, Jan. 15, 1921.
[7] Eng. and Min. Jour., vol. 109, p. 1423, June 26, 1920.
[8] Statistique de l'industrie minérale et des appareils à vapeur en France et en Algérie, 1913-1919.

The production of aluminum in Norway in 1919,[9] was 3,120 metric tons, as compared with 6,834 tons in 1918 and 7,600 tons in 1917. The aluminum works of Norway are the Tyssedal and d'Eydehyn plants of Det Norske Nitrit Ak, the Hoyang plant of the Norsk Aluminium Co., and the Vigeland and Stangfjord plants of the A/S Vigelands Brug. To judge from this article the experiments of the Norsk Aluminium Co., looking to the extraction of aluminum from labradorite, have not yet met with commercial success.

The Mining Journal [10] (London) has given some information concerning the probable capacity of the German aluminum industry, from which it may be judged that an output between 25,000 and 40,000 tons, probably nearer the lower estimate, may be assumed as correct. A large part of the German industry was based on lignite for power, which would hardly seem to warrant the belief that it can long survive a return to more normal conditions. The war contract of the German Government for aluminum with the Swiss Aluminum Industrie A. G., of Neuhausen, was finally canceled by payment of 11,000,000 Swiss francs to the company.[11]

The production of aluminum in Italy in 1919 [12] was 1,673 metric tons, as compared with 1,715 tons in 1918.

ALUMINUM SALTS.

The quantity of aluminum salts reported to the Geological Survey as marketed by commercial plants and used by industrial works in 1920 was 258,009 short tons, valued at $9,968,174, which was an increase of 15 per cent in quantity and 22 per cent in value, as compared with the production in 1919.

In 1920 eight plants in the central and eastern United States produced 16,824 short tons of alum. This was a decrease of about 1 per cent from the production in 1919. The value of the output in 1920 was $992,259, which was nearly 13 per cent higher than in 1919. The average price for alum sold in 1920, $58.98 a ton, was 14 per cent higher than in 1919.

Aluminum chloride amounting to 3,571 tons was made at three plants in the United States in 1920. This was a decrease of 26 per cent compared with the output of 1919. The value of the production in 1920 was $297,550, indicating an average price of $83.32 a ton.

Aluminum sulphate was made at 24 plants, of which 6 were at municipal waterworks that used their entire output. The 18 commercial plants produced 229,888 tons of aluminum sulphate, having a value of $8,104,457, in 1920, an increase of nearly 18 per cent in quantity and 23 per cent in value, as compared with the production of commercial plants in 1919. The average price of the aluminum sulphate produced by commercial plants in 1920 was $35.25 a ton, an increase of 4 per cent, as compared with the average for 1919. The municipal waterworks plants produced 4,115 tons of aluminum sulphate in 1920, as compared with 4,725 tons in 1919. It is reported

[9] The electrochemical industries of Norway in 1919: Jour. four électrique, 29th year, Nos. 7–8, pp. 59–61, May, 1920.
[10] Editions of March 20, April 10, and July 17, 1920.
[11] Commerce Repts., March 12, 1920.
[12] Rivista del servizio minerario nel 1918, and Revista minera, metalúrgica y de ingeniería, año 72, No. 2769, pp. 48–49.

that at least two additional waterworks are installing equipment to make their own aluminum sulphate.

Alum and aluminum sulphate produced in the United States and aluminum salts imported, 1916–1920.

Year.	Production.						Imports.[a]	
	Alum.			Aluminum sulphate.			Quantity (short tons).	Value.
	Quantity (short tons).	Value.	Price per ton.	Quantity (short tons).	Value.	Price per ton.		
1916	27,257	$1,177,881	$43.21	153,860	$4,410,741	$28.67	1,247	$68,660
1917	19,714	1,017,083	51.60	178,738	5,746,427	32.15	507	39,088
1918	20,286	1,051,449	51.83	209,079	6,473,086	30.96	231	18,519
1919	17,019	879,198	51.66	200,034	6,763,063	33.80	343	21,877
1920	16,824	992,259	58.98	234,003	8,228,713	35.16	1,340	69,896

[a] Includes alumina, aluminum hydrate or refined bauxite, alum, alum cake, aluminum sulphate, aluminous cake, and alum in crystals or ground.

BAUXITE ABRASIVES.

Bauxite abrasives, sold under various trade names, such as alundum, aloxite, exolon, and lionite, are made by fusing bauxite in an electric furnace. These products are sold in the form of powders, cloth, grinding stones and wheels of various shapes, and for a multitude of uses. It is not possible to give figures showing the output of bauxite abrasives, but the consumption of bauxite by abrasive manufacturers indicates in general the trend of the industry. Abrasive makers purchased 52,276 long tons in 1920, an increase of 48 per cent as compared with 1919, but less than half of the purchases in 1918.

BAUXITE REFRACTORIES.

Two classes of high-alumina refractories are now on the market. What are commonly called bauxite brick are made by mixing various proportions of calcined bauxite or high-alumina clay with a bonding material such as fire clay, sodium silicate, or lime. The other class consists of refractories made by the electric fusing of bauxite. These are manufactured by the companies that make artificial abrasives.

No figures are available to show the production of high-alumina refractories, though it is known that at least 2,313 tons of bauxite was consumed in making them in 1917, 9,874 tons in 1918, and 1,059 tons in 1919. None was reported as sold to makers of refractories in 1920, though it is believed that some bauxite and high-alumina clay (diasporite), from the deposits in central Missouri, were used by makers of refractories.

PLATINUM AND ALLIED METALS.

By James M. Hill.

DOMESTIC PRODUCTION.

CRUDE PLATINUM.

Mine returns for the year 1919 are now available and indicate that the figures for California—683 ounces of crude platinum containing 503 ounces of refined platinum metals—as published in the report on platinum and allied metals in 1919, were essentially correct. The published figures for Oregon—119 ounces—are very much higher than the quantity reported by the miners, which was only 37 ounces of crude platinum. It is believed that the refiners' figures may represent purchases of accumulated stocks of platinum brought out by the high prices, whereas the miners' reports are more representative of the actual condition of mining, though it is realized that the reports from Oregon mines for 1919 are not so complete as could be wished. The Alaskan figures as given are correct.

Mine returns for 1920, although not entirely complete at the date of writing, April 30, 1921, indicate that the production of crude platinum metals was about as follows: California, 656 ounces, part of which was nearly pure osmiridium and was sold to consumers, not to refiners; Oregon, 36 ounces, part of which came from beach mines in Coos and Curry counties and part from the dredges near Sumpter, Baker County.

Platinum refiners report purchase of domestic crude platinum in 1920 as follows: From California mines 555 ounces, as compared with 683 ounces in 1919; from Oregon mines 23 ounces, as compared with 119 ounces in 1919; from Washington mines 8 ounces, as compared with none in 1919; and from Alaska mines 27 ounces, as compared with 22 ounces in 1919. The total recovery of refined metals from the 613 ounces of crude platinum purchased by refiners in 1920 was 488 ounces, showing that the United States crude platinum averages approximately 80 per cent of platinum metals. This was made up of 59 per cent of platinum, 16 per cent of iridium, and 5 per cent of palladium and osmiridium. Some lots of domestic crude platinum, largely from Trinity County, Calif., sold to refiners in 1920 carried more than 60 per cent of osmiridium. The crude platinum saved by the dredges along the Sierra Nevada foothills carries comparatively little iridium.

Refiners report the purchase of 23,009 ounces of foreign crude platinum, from which a total of 19,504 troy ounces, or an average of

approximately 85 per cent, of refined platinum metals was recovered. The great bulk of the foreign crude material treated by refiners came from Colombia; small quantities were received from Canada and Australia.

REFINED PLATINUM METALS.

NEW METALS.

Reports received from refiners of platinum, gold bullion, nickel, and copper indicate that 41,544 troy ounces of refined new metals of the platinum group were recovered in 1920, a decrease of 3,565 ounces compared with the recoveries in 1919. As will be seen from the following table, the platinum recovered in 1920 was about 10 per cent less than in 1919, but the palladium recovered in 1920 was about 13 per cent more than in 1919. As nearly as can be estimated, about 13,243 ounces of the new metals recovered in 1920 were derived from domestic material.

New platinum and allied metals recovered by refiners, 1916–1920, in troy ounces.

Year.	Platinum.	Iridium.	Iridosmine-osmiridium.	Palladium.	Other.
1916	24,518	370	315	2,885	.....
1917	33,009	210	833	4,779	.....
1918	54,399	465	539	4,024	326
1919	40,220	401	402	3,807	279
1920	35,015	418	409	4,309	393

The estimate of recoveries from domestic material includes 488 ounces from crude placer platinum, 1,092 ounces from ore and concentrates carrying platinum metals, and 11,663 ounces from the refining of gold bullion and copper. The last figure is open to question and probably includes platinum metals recovered from scrap materials. The metals are recovered by the electrolytic refining of a variety of materials and are obtained only after a considerable time. It is almost impossible to arrive at an accurate figure, but the estimate given is based on the best information available. This estimate does not include the platinum metals recovered by the International Nickel Co. at its works at Bayonne, N. J.

SECONDARY METALS.

Secondary platinum metals are those recovered by treating scrap metals, sweepings, and other waste products of manufacture that contain platinum. Although the reports undoubtedly cover some duplication, it is believed that they are of importance, for the metals so obtained constitute a large part of the domestic supply of platinum—nearly 28 per cent in 1920. Refiners report recoveries of 57,710 ounces of secondary platinum metals in 1920, a decrease of 3,806 ounces compared with the recoveries in 1919.

Secondary platinum and allied metals recovered, 1916–1920, in troy ounces.

Year.	Platinum.	Iridium.	Palladium.
1916	45,156	1,535	1,284
1917	59,007	9,832	3,347
1918	40,378	3,410	1,795
1919	54,545	3,504	3,467
1920	51,255	3,355	3,100

IMPORTS.

The imports of platinum and allied metals for consumption in 1920, as given by the Bureau of Foreign and Domestic Commerce,[1] were approximately 48 per cent larger than during 1919, 77 per cent larger than in 1918, and approached the pre-war average of approximately 110,000 ounces.

Platinum and allied metals imported for consumption in the United States, 1919 and 1920.

Metal.	1919		1920	
	Quantity (troy ounces).	Value.	Quantity (troy ounces).	Value.
Platinum or crude platinum and unmanufactured products, ingots, bars, sheets, wire	54,550	$5,229,309	80,955	$8,474,499
Platinum, manufactured products, vases, retorts, etc.	22	[a] 17,213	781	[b] 94,408
Iridium	5,808	975,174	4,718	726,502
Osmiridium	1,374	112,403	4,473	450,241
Osmium	2,339	132,097	593	39,517
Palladium	3,739	250,777	6,944	612,248
Rhodium	222	30,474	2,053	217,385
Ruthenium	.....	.....	29	2,640
	68,054	6,747,447	100,546	10,617,440

[a] Includes wire to the value of $11,720 imported under 15 per cent duty, quantity not given, and "all other" to the value of $2,821, quantity not given.

[b] Includes wire to the value of $5,433 imported under 15 per cent duty, quantity not given, and "all other" to the value of $10,278 imported under 50 per cent duty, quantity not given.

[1] The data for this table were compiled by J. A. Dorsey, of the U. S. Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Platinum imported into the United States, 1919 and 1920.

[General imports.]

Country.	Unmanufactured.		Ingots, bars, plates, etc.		Vases, retorts, etc., for chemical use.		All other platinum.	Total value.
	Quantity (troy ounces).	Value.	Quantity (troy ounces).	Value.	Quantity (troy ounces).	Value.		
1919.								
France	4,959	$514,197	454	$49,218			$2,737	$566,152
Netherlands			5	446	1	$489		935
Spain			65	6,825			84	6,909
England	17,554	1,793,276	3,431	382,324	10	1,046	11,720	2,188,366
Canada	72	7,419	106	9,889	11	1,137		18,445
Panama	1,032	84,902						84,902
Mexico			2	210				210
Jamaica			2	175				175
Cuba	43	5,210						5,210
Brazil	33	2,997						2,997
Colombia	23,585	2.087,061	2,461	216,150				2,303,211
Peru	12	961						961
Uruguay	4	420						420
Venezuela	16	1,683	2	100				1,783
China	84	8,355	45	4,700				13,055
British India			2	200				200
Japan	80	6,979	1	112				7,091
Russia in Asia	400	35,000						35,000
Australia	44	5,400						5,400
New Zealand	2	206						206
British South Africa	27	2,287	27	2,607				4,894
	47,947	4,556,353	6,603	672,956	22	2,672	14,541	5,246,522
1920.								
Belgium	784	91,550	95	9,708				101,258
Denmark	30	4,050	7	1,077				5,127
France	10,557	1,136,377	1,917	202,248	12	1,305	10,064	1,349,994
Germany	11	1,168	84	8,599	(a)	5	204	9,976
Netherlands	291	29,873	112	10,440	12	1,334		41,647
Norway	951	91,906						91,906
Switzerland					16	1,886		1,886
England	16,307	1,740,837	17,152	1,895,819	738	73,910	5,433	3,715,999
Ireland	29	3,898						3,898
Canada	589	55,008	193	15,130	1	136	10	70,284
Costa Rica			2	173				173
Panama	346	37,126						37,126
Mexico	3	251						251
Argentina	154	12,863						12,863
Brazil			54	5,204				5,204
Chile	248	33,537						33,537
Colombia	26,343	2,607,211	3,510	273,676				2,880,887
Ecuador	27	2,629						2,629
Venezuela	4	320						320
China			5	352				352
Dutch East Indies			10	1,005	2	121		1,126
Russia in Asia	833	175,000						175,000
Australia	305	27,264						27,264
New Zealand			2	200				200
	57,812	6,050,868	23,143	2,423,631	781	78,697	15,711	8,568,907

(a) Less than 1 ounce.

A study of the import tables shows that Colombia still supplies the United States with most of its crude platinum. England sent 33,459 ounces of unmanufactured platinum in 1920, as compared with 20,985 ounces in 1919; France 12,474 ounces, as compared with 5,413 ounces in 1919. Presumably a large part of the metal imported from England and France is refined.

EXPORTS.

Exports of platinum, as recorded by the Bureau of Foreign and Domestic Commerce[2] in 1920, were 1,302 ounces of unmanufactured platinum, valued at $177,115, and manufactures of platinum to the value of $111,014. The exports of unmanufactured platinum were 200 ounces to Canada and 1,102 ounces to Japan. All the manufactured platinum went to Japan.

CONSUMPTION.

The following tabulation of the information supplied by dealers as to the consumption of platinum, iridium, and palladium in the various industries is of interest in showing the changes due to changed conditions. The jewelers continue to use more than half of the platinum metals consumed, and the electrical industry 19 per cent. The use of palladium-gold alloys by jewelers apparently diminished greatly, for this industry used only one-third as much palladium in 1920 as in 1919.

The total consumption of these platinum metals in 1920 decreased approximately 9 per cent from the consumption in 1919 but increased 22.4 per cent over the consumption in 1918.

Platinum, iridium, and palladium used in the United States in 1918–1920 by consuming industries, in troy ounces.

Industry.	Platinum.	Iridium.	Palladium.	Total.	Percentage of total.
1918.					
Chemical	45,391	717	834	46,942	41
Electrical	24,982	3,107	594	28,683	25
Dental	11,461	418	7,371	19,250	17
Jewelry	13,541	721	42	14,304	12
Miscellaneous	5,435	339	212	5,986	5
	100,810	5,302	9,053	115,165	100
1919.					
Chemical	10,759	41	63	10,863	7
Electrical	23,875	3,534	1,283	28,692	19
Dental	11,047	185	10,311	21,543	14
Jewelry	82,397	3,145	1,460	87,002	56
Miscellaneous	5,602	596	445	6,643	4
	133,680	7,501	13,562	154,743	100
1920.					
Chemical	13,226	43	240	13,509	9.58
Electrical	23,029	2,673	1,784	27,486	19.49
Dental	6,413	114	8,898	15,425	10.94
Jewelry	77,267	3,108	593	80,968	57.40
Miscellaneous	3,119	116	418	3,653	2.59
	123,054	6,054	11,933	141,041	100.00

The consumption of these platinum metals can be arrived at in another way, as is shown in the following table. In using this method, because of the inexactness of certain of the tariff classifications, assumptions have to be made that can not be verified, yet it is of interest to compare the results obtained by the two methods, which check for the year 1920 within approximately 1,000 ounces, or an error of less than 1 per cent.

[2] Figures compiled by J. A. Dorsey from records of Department of Commerce.

Platinum, iridium, and palladium consumed in the United States in 1919 and 1920, in troy ounces.

	Platinum.	Iridium.	Palladium.	Total.
1919.				
Stocks on hand Dec. 31, 1918 (unmanufactured and manufactured)	51,504	3,224	10,086	64,814
Production, new metals, 1919	40,220	401	3,807	44,428
Production, secondary metals, 1919	54,545	3,504	3,467	61,516
Imports [a]	19,939	5,808	3,739	29,486
Total available for consumption	166,208	12,937	21,099	200,244
Stocks on hand Dec. 31, 1919 (unmanufactured and manufactured)	29,228	3,359	10,235	42,822
	136,980	9,578	10,864	157,422
Exports [b]	1,000			1,000
Apparent consumption	135,980	9,578	10,864	156,422
1920.				
Stocks on hand Dec. 31, 1919 (unmanufactured and manufactured)	29,228	3,359	10,235	42,822
Production, new metals, 1920	36,015	418	4,309	40,742
Production, secondary metals, 1920	51,255	3,355	3,100	57,710
Imports [a]	58,009	4,718	6,944	69,671
Total available for consumption	174,507	11,850	24,588	210,945
Stocks on hand Dec. 31, 1920 (unmanufactured and manufactured)	46,747	4,196	16,565	67,508
	127,760	7,654	8,023	143,437
Exports [b]	1,350			1,350
Apparent consumption	126,410	7,654	8,023	142,087

[a] The figure for platinum imported is estimated on the assumption that all the foreign crude platinum was reported by refiners and the product of the refining is included in the item "Production, new metals." The remainder of the imported material under the classification "Unmanufactured" and "Ingots, bars, etc.," is assumed to be refined platinum.

[b] The quantity of platinum exported is not given for manufactures, but has been estimated at the average price of finished platinum ware.

STOCKS OF PLATINUM METALS.

Refiners and dealers in platinum metals reported stocks of 67,508 ounces on December 31, 1920, as compared with 43,432 ounces in 1919. It will be noted that the following table indicates that the greater part of the stock is carried in the unmanufactured state. This indication is not believed to be accurate, but it is accepted, as some refiners and dealers do not segregate the items. It is pleasing to record the accumulation of stocks, which increased some 24,076 ounces over the stocks of 1919, an increase of more than 55 per cent. The increase was due not only to the lessened consumption, but still more to the increased imports.

Stocks of platinum metals on hand Dec. 31, 1918–1920, in troy ounces.

Metal.	Unmanufactured.	Manufactured articles.	Total.
1918.			
Platinum	17,740	33,764	51,504
Iridium	2,259	965	3,224
Palladium	7,141	2,945	10,086
	27,140	37,674	64,814
1919.			
Platinum	21,720	7,508	29,228
Iridium	2,970	389	3,359
Palladium	8,540	1,695	10,235
Other	42	568	610
	33,272	10,160	43,432
1920.			
Platinum	40,467	6,280	46,747
Iridium	3,988	208	4,196
Palladium	14,907	1,658	16,565
	59,362	8,146	67,508

MARKET AND PRICES.

REFINED METALS.

The market price of platinum, which in January was around $154 an ounce, was not strong during 1920 and declined to $80–$85 an ounce the last week in July. A slight revival was noted in August, due apparently to buying by jewelers, which resulted in prices rising to $115–$120 the first of September, but by the end of September prices began to fall and the last of December they reached $75 an ounce.

Palladium was quoted at $135 an ounce at the first of the year but declined to $75–$80 an ounce in July. There was a slight revival of the market, following that of platinum, and the price reached a peak of $100–$110 the first of October. After that the price declined to $75 at the end of the year.

Iridium was quoted at more than $300 an ounce throughout the year—during the period between September and December at $350–$400 and during the second half of October at $400–$450 an ounce.

The 10 per cent iridio-platinum alloy used by jewelers was selling at $180–$185 an ounce in January, 1920, but by June had declined to $115–$118 an ounce. There was an increase during August and September, when the highest price recorded was $167 an ounce. By the end of the year the price had declined to $125 an ounce.

Average prices of platinum per troy ounce in the New York market, 1913–1920.[3]

1913	$44.88
1914	45.06
1915	49.63
1916	83.40
1917	102.82
1918	105.95
1919	114.60
1920:	
January	154.00
February	152.50
March	140.20
April	128.50
May	96.10
June	85.50
July	82.50
August	111.00
September	115.62
October	103.50
November	89.39
December	80.00
Average for 1920	111.58

The United States Geological Survey has used the prices given in the following table in calculating the value of platinum metals. As will be noted, these figures do not in all respects agree with the open-market quotations that are given in the foregoing table. The accepted figures are, however, believed to represent more nearly the actual sales.

Average price per troy ounce of refined metals of the platinum group, 1914–1920.

Metal.	1914	1915	1916	1917	1918	1919	1920
Platinum	$45	$55	$84	$103	$105	$123	$111
Iridium	65	83	94	150	175	255	331
Iridosmine	33	35	45	80	90	105	150
Palladium	44	56	67	110	135	130	108

CRUDE PLATINUM.

Domestic producers of placer platinum received from $50 to $198 an ounce for their crude platinum in 1920, as compared with $63 to $108 an ounce in 1919. The price paid for various lots depends so much upon the care that has been used in cleaning the metal before shipment and upon its content in the various platinum group metals that it is impossible to give an idea of what price may be expected. Many of the buyers are now purchasing on the basis of metal content, which should be much more satisfactory to all concerned.

Some Australian crude platinum, presumably mostly osmiridium, brought $163 an ounce. The average price paid for Colombian crude in 1920 was $103.

The principal buyers of foreign and domestic crude platinum in the United States are listed below.

American Platinum Works, 325 New Jersey Railroad Avenue, Newark, N. J.
Baker & Co. (Inc.), Murray and Austin Streets, Newark, N. J.
David Belais, 13 Dutch Street, New York, N. Y.
Sigmund Cohn, 44 Gold Street, New York, N. Y.

[3] Eng. and Min. Jour., vols. 109 and 110, weekly quotations.

Goldsmith Bros. Smelting & Refining Co., 20 John Street, New York, N. Y.
Gracier, Klink & Young, 409 Montgomery Street, San Francisco, Calif.
Johnson Matthey & Co. (Inc.), Woolworth Building, New York, N. Y.
Kastenhuber & Lehrfeld, 24 John Street, New York, N. Y.
Pacific Platinum Works, 229 East Ninth Street, Los Angeles, Calif.
R. & H. Platinum Works, 709 Sixth Avenue, New York, N. Y.
Shreve & Co., Post and Grant Streets, San Francisco, Calif.
Wildberg Brothers, 414–419 Pacific Building, San Francisco, Calif.
H. A. Wilson Co., 97 Chestnut Street, Newark, N. J.

WORLD'S PRODUCTION.

Statistics of the world's production of platinum and allied metals are at best estimates, though they are derived from the most reliable information obtainable.

Estimated world's production of crude platinum from placers, 1912–1920, in troy ounces.

Country.	1912	1913	1914	1915	1916	1917	1918	1919	1920
Australia:									
New South Wales [a]	610	442	244	56	82	259	607	213	[b]
Tasmania [c]	779	1,262	1,019	247	222	332	1,607	1,670	2,009
British India [d]	57	58	37	18	9	4	[e]	.....	.....
Canada [f]	30	50	30	100	60	80	40	30	25
Colombia	12,000	15,000	17,500	18,000	25,000	32,000	35,000	35,000	35,000
Russia	300,000	250,000	241,200	124,000	63,900	50,000	25,000	30,000	35,000
United States	721	483	570	742	750	605	647	824	613

[a] Ann. Rept. Dept. of Mines.
[b] No basis for estimate.
[c] Ann. Rept. Sec. for Mines. Tasmanian production all osmiridium.
[d] Records Geol. Sur. India, Ann.
[e] Production less than 1 ounce (0.31 ounce).
[f] Canadian official figures of Ann. Rept. Dept. of Mines (believed low) are: 1912, none; 1913, 13; 1914, none; 1915, 23; 1916, 15; 1917, 57; 1918, 39; 1919, 25; 1920, 17.

NOTES ON PLATINUM DEPOSITS.

UNITED STATES.

No rich palladium-bearing ores were shipped from the Boss mine in Clark County, Nev., in 1920, though a small quantity of copper ore from this mine was smelted.

The Rambler mine, in Albany County, Wyo., was sold with other properties to the Iron Blossom Mining Co. in 1920 and has been under development during the year. This property is now known as the Electrolytic mine.

The Salt Chuck mine, at the head of Kasaan Bay, Prince of Wales Island, Alaska, continued its production of palladium-bearing bornite ore. The ore bodies, according to Mertie,[3a] are irregularly placed along or near a well-defined shear zone in peridotite. There is some indication of downward enrichment at a depth of 200 feet, but the proportion of secondary sulphides is small. The average ore carries 1.427 per cent of copper and 0.063 ounce of gold, 0.217 ounce of silver and 0.253 ounce of platinum metals to the ton. The flotation concentrates shipped average 40.06 per cent of copper and 1.213 ounces of gold, 5.293 ounces of silver, and 3.147 ounces of platinum metals to the ton. In the average ore the ratio of gold to silver to platinum metals is 1 to 3 to 4; in picked samples of chalcopyrite

[3a] Mertie, J. B., jr., The Salt Chuck palladium-copper mine: Eng. and Min. Jour., vol. 110, No. 1, pp. 17-20, July 3, 1920.

it is 1 to 19 to 9. Mertie interprets this difference as indicating that the platinum metals and silver are associated closely with the copper minerals and that the gold is more widely disseminated in the country rock.

In October, 1920, the Platinum-Palladium Producing Corporation, of Washington, was organized to take over the Salt Chuck mines. It has an authorized capital of 150,000 shares of stock of $10 par value and $300,000 first mortgage convertible 8 per cent bonds.

Of the 656 ounces of crude platinum reported by miners as produced in California in 1920 the dredges at the base of the Sierra Nevada supplied 448 ounces and the mines of Trinity and Shasta counties contributed 208 ounces.

The mines of Coos and Curry counties, Oreg., produced 17 ounces of crude platinum in 1920, most of which was taken from beach diggings. Some platinum was saved as a by-product at the dredges in Baker County.

The United States Supreme Court has decided adversely on the so-called Cameron claims near the Bright Angel trail in Arizona.

CANADA.

There are reports [4] of the possibility of saving a by-product at the Consolidated Cariboo hydraulic mine, in the Quesnel district of British Columbia, which is rich in the platinum metals. Apparently the drilling at Franklin Camp, British Columbia, on a belt of pyroxenite, which was done at the request of the Provincial government,[5] has met with some measure of success, as later information [6] states that platinum metals have been found in paying quantities. Palladium, platinum, and small quantities of iridium, rhodium, and osmium were produced at the refineries of the International Nickel Co.[7] at Port Colburn, Ontario, and Bayonne, N. J.

CHILE.

Beach deposits, somewhat similar to those on the California and Oregon coasts, on the island of Chiloe, off the coast of Chile, have recently been described.[8] The beaches at the south end of the island are richer in platinum than those at the north end, but, as Mella states,

> The investigations lead to the conclusion that though extensive deposits of black sand exist on the northern beaches, they contain only occasional traces of platinum, and their gold values are both too erratic in distribution and too low in grade to permit of their profitable exploitation. It is possible that systematic prospecting on other southern beaches would disclose platinum-bearing sands that might be profitably exploited with high prices obtainable for the metal, but the limited extent of the beaches would indicate that no large deposits could be expected.

COLOMBIA.

According to figures of the Department of Commerce (see table, p. 40), 29,853 ounces of platinum was imported from Colombia in 1920. Refiners report the purchase of only 22,648 ounces. It is

[4] Platinum in British Columbia: Min. and Sci. Press, vol. 120, No. 15, p. 536, April 10, 1920.
[5] Min. and Sci. Press, vol. 120, No. 16, pp. 582–584, April 17, 1920.
[6] Eng. and Min. Jour., vol. 111, No. 13, p. 563, Mar. 26, 1921.
[7] Canada Dept. Mines Prelim. Rept., 1920.
[8] Mella, Fritz, Black sand deposits of the island of Chiloe: Eng. and Min. Jour., vol. 111, No. 12, pp. 497–501, March 19, 1921.

possible that some importing agents held their supplies received late in 1920, hoping for a rise in the market.

The South American Gold & Platinum Co. has two dredges working on Condoto River, near Andagoya, Choco Province; the second dredge was put into operation August 16, 1920. According to the report of the Consolidated Goldfields of South Africa,[9] which is interested in the South American Gold & Platinum Co., the old dredge produced 6,349.2 ounces of platinum in 10 months of operation in 1919 and the rate of production for the first eight months of 1920 showed a substantial increase over the rate in 1919. A third dredge of larger capacity than either of the two in operation is now being built in the United States. It is reported that this company has recently completed negotiations which will give it control of a considerable area of dredgeable ground on the headwaters of the Atrato.

The first dredge of the British Platinum & Gold Corporation was reported[10] to have begun digging in October, 1920, on Opogodó River of the San Juan drainage basin.

RUSSIA.

There is no authentic information concerning the platinum industry in Russia. The soviet government had planned to produce 3,000 pounds of platinum in 1920, but it is reported to have been able to produce only 241 pounds in the first six months, or at the rate of approximately 500 pounds for the whole year. The suggestion of the Mining and Scientific Press[11] that this may be poods, not pounds, is not admissible, for 500 poods would be 263,322 troy ounces, and it is inconceivable that any such quantity of platinum was produced. What appears to be more reliable information[12] as to the production for the first seven months of 1920 puts the output at 6 poods, or 3,160 ounces.

It is known that certain gravels in the platinum-producing areas are sufficiently rich to be worked by hand, and it is probable that some platinum was thus recovered in 1920, possibly as much as 15,000 ounces, in view of the fact that the soviet government was anxious to produce the metal in the hope that it could be used as a medium of exchange with the rest of the world.

TASMANIA.

The Tasmanian osmiridium fields were apparently exploited actively during 1920, for the production of 2,009 ounces recorded is about 403 ounces greater than the output in 1918 and 340 ounces more than the production in 1919. The output in 1920 was sold for £77,114, which at the average exchange during 1920 (£1 = $3.65) was equivalent to $281,466, or at the rate of $140 an ounce, which was $10 an ounce below the average price paid for osmiridium in the United States.

[9] American operations of the Consolidated Goldfields of South Africa: Min. and Sci. Press, vol. 121, p. 881, Dec. 18, 1920.
[10] Min. Jour. (London), vol. 23, p. 74, August, 1920.
[11] Vol. 121, No. 12, p. 401, Sept. 18, 1920.
[12] Russia's gold and platinum output: Econ. Review, vol. 2, No. 23, p. 512, 1920.

PLATINUM ASSAYING.

As is well known, the textbook methods for the assay of platinum have not proved effective. Many people have been fooled by the results of assayers, most of whom, presumably following standard methods, are not sufficiently familiar with the difficulties of platinum analysis to recognize the errors that might arise in their work. The difficulties of platinum analysis are well known, and statements have been repeatedly published emphasizing the necessity of employing only assayers who are recognized as competent to undertake this class of work. The Bureau of Mines has recently issued a comprehensive review [13] of the various methods that have been used and gives in detail a method which can be considered standard. As this method has been shown to be absolutely reliable, when followed by a competent assayer, for the detection of platinum metals in all classes of samples, it is believed that it should be accepted. It is suggested that any one desiring assays for platinum should insist upon the assayer using this method. If this is done and check assays are required later, the results can be compared with safety.

The importance to all those interested in platinum of the method published by the Bureau of Mines seems to justify its repetition here, though the whole report should be in the hands of each assayer who may be called upon to assay ores for platinum.

SELECTED METHOD FOR THE COMMERCIAL ESTIMATION OF PLATINUM IN ORES.

In the investigation of methods for the detection and estimation of platinum in vein material, the method following has been selected as satisfactory for commercial use. It contains nothing new, but has been compiled from various sources and is similar to one used by L. W. Dunham, Irvington, N. J.[14] The manipulation has been given in detail and notes added to explain the various steps in the process. Although a separation of the platinum metals is not given, the rough group separations are included to aid in determining the value of an ore.

The bead obtained by usual fire-assay methods may contain gold, silver, and the platinum metals and is parted with HNO_3. The silver and most of the platinum and palladium go into solution. The residue may contain gold, iridium, rhodium, and some ruthenium and osmium, as well as platinum. The gold and the rest of the platinum are dissolved from the residue of other platinum metals with dilute aqua regia and filtered off, leaving iridium, rhodium, part of the ruthenium, and a small amount of osmium, which may be ignited and weighed. The HNO_3 solution may contain silver, platinum, and palladium. The silver is removed, as the chloride and the platinum and palladium are precipitated from the solution (which has been made slightly alkaline with Na_2CO_3), by boiling with formic acid, then filtered, ignited, and weighed. To separate the palladium from the platinum the mixed metals are treated with warm dilute HNO_3, which dissolves the palladium and leaves the platinum. The palladium is found by difference, or may be precipitated with formic acid, after evaporating to dryness with HCl, taking up with water, and neutralizing with Na_2CO_3. The aqua regia solution is evaporated to dryness twice with HCl, taken up with water, and, after the gold is removed with oxalic acid, the platinum and palladium are recovered as in the preceding process. A qualitative test is applied to a solution of the platinum precipitate.

The ore in all cases is ground to pass a 100-mesh screen and when substances difficult to fuse, such as chromite and zircon, are present, the sample should be made to pass a 150-mesh screen.

When the quantity of platinum is small, it is advisable to run several samples of an assay ton each, combine the lead buttons, and scorify to about 30 grams.

An assay ton of the carefully sampled ore is thoroughly mixed with a suitable flux. As iron has a greater affinity for iridium than has lead, the old iron-nail method of treating sulphide ores should not be used.

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[13] Davis, C. W., The detection and estimation of platinum in ores: U. S. Bur. Mines Tech. Paper 270.
[14] Private communication, 1920.

If there is not at least 15 times as much silver as platinum in the ore, enough of a silver salt—chloride or nitrate—is added to make up the deficiency. The presence of excess silver is required to render the platinum soluble in HNO_3, when parting, to assist in removing the last traces of lead in cupelling and to lessen any tendency toward loss in the cupel. The addition of silver in the form of a salt makes possible a thorough mixing with the charge, and, when reduced, the numerous silver particles are distributed in a way to be most effective in collecting the platinum.

To an unknown ore about 0.05 gram of silver chloride may be added. The charge is fluxed as in the ordinary fire assay for gold and silver, except that after the fusion has become quiet the temperature should be raised somewhat higher than is the usual practice and the heating continued for about an hour. The crucible is removed from the furnace without agitating the contents and left to cool. Cooling without agitation prevents loss of iridium, ruthenium, and osmiridium, which do not alloy with lead but sink through it and are held mechanically when the button cools. If the charge is poured, these metals are apt to be partly lost.

The button is freed from slag and cupelled at a high temperature. As the high temperature causes a loss of silver, a check or proof assay should be run at the same time to be used in correcting this error.

When platinum makes up over 1.6 per cent of the bead, the latter appears frosted to the unaided eye. The microscope will detect platinum when it constitutes 0.3 per cent of the silver bead. Considerable quantities of platinum make the bead flat and irregular. The roughness caused by iridium is of finer texture than that due to platinum. Palladium gives the surface of the bead an embossed appearance. Ruthenium in quantity turns the surface to a bluish-black color, a black scum being left on the cupel. After cupelling, the button is then parted with HNO_3, first with 1:4, then with 1:1, and finally with 2:1 acid. If gold, silver, and all the platinum metals are present in the ore, the silver, palladium, and platinum are dissolved by this treatment, leaving the gold, iridium, rhodium, and some ruthenium and osmium. Most of the osmium and part of the ruthenium are oxidized and lost during cupellation. Part of the iridium may not collect in the silver and will be lost on the cupel.

If considerable platinum is found, some will be left still undissolved. The residue is filtered off on a 5-centimeter, ashless filter paper, ignited, and saved for the recovery of any residual platinum as well as for the determination of iridium and rhodium.

Dilute HCl is then added to the filtrate slowly, with constant stirring to precipitate the silver. After this has set over night, the silver chloride is filtered off and washed with water, acidulated with HNO_3. If the precipitate is pink, it must be redissolved and again precipitated to remove occluded platinum or palladium. Although palladium may be separated from silver by one precipitation as the chloride, in acetic acid solution, the addition of the ammonia necessary to neutralize the HNO_3 present causes a bulk of salts on evaporation, which interfere with the subsequent operations.

Evaporate the filtrate just to dryness, do not bake; take up with dilute HCl and again evaporate just to dryness, then take up with dilute HCl, transfer to a 30-cubic centimeter beaker and evaporate nearly to dryness (until there is a dry spot in the center of the beaker). When cold, take up with a very little cold water and filter on a 5-centimeter paper to remove the last traces of silver. It is important that all the silver be removed at this point, otherwise silver would come down on boiling with formic acid and vitiate the platinum-palladium result.

The filtrate is made slightly alkaline with Na_2CO_3, formic acid added, and the solution boiled in a covered beaker until all the platinum and palladium are precipitated (about 30 minutes). These finely divided metals are filtered on a small (5-centimeter or less) paper, washed with hot water, ignited, and weighed. As the platinum metals adhere to both glazed and unglazed porcelain crucibles on ignition, "impervite" crucibles may be used to advantage for the ignition of the finely divided metals. In transferring the platinum metals from the beaker to the filter, it has been found convenient to use a small wash-bottle which will deliver a very fine stream of water. Funnels that have been cut down so that the small filter papers extend beyond the rim prevent the fine metals from creeping.

The filtrate should be boiled again with formic acid to confirm a complete precipitation of the platinum metals.

If the first parting solution is yellow or orange, the presence of palladium is indicated and the platinum may be separated from the palladium and determined. Warm the metals with dilute HNO_3 (1:4) which quickly and completely dissolves the palladium, filter, wash, ignite, and weigh the pure platinum. The palladium may be found by difference, or it may be precipitated by formic acid from the solution obtained by evaporating to dryness with HCl, dissolving in water, and neutralizing with Na_2CO_3.

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The residue from HNO_3 parting (which may contain gold, iridium, and rhodium, as well as some ruthenium, osmium, and undissolved platinum) is treated with 1:5 aqua regia, dissolving the gold and platinum. The residual platinum metals are filtered off on a small filter paper, ignited (using "impervite" crucibles), and weighed. The aqua regia solution, which may contain gold and platinum, is evaporated to dryness, taken up with HCl and again evaporated to dryness, then extracted a second time with HCl, evaporated nearly to dryness, taken up with cold water, and any residual matter is filtered off. The solution is then boiled with oxalic acid until the gold is all precipitated. It is well to let the solution stand overnight before filtering off the gold. The gold is filtered off and the platinum, recovered by boiling the solution which has first been neutralized with sodium carbonate with formic acid, is then filtered off, ignited, and its weight added to that of the platinum already found.

It is advisable to check results by running a known sample along with the unknown. This known sample is made by adding to a crucible charge the approximate quantity of gold, silver, and platinum found in the ore. The check is treated in every way the same as the sample to be examined, the latter being corrected if the known sample shows a discrepancy.

The resulting platinum and palladium should be dissolved separately in aqua regia, taken to dryness twice with HCl, extracted with water, and, after each solution has been acidified with HCl, tested qualitatively, KI giving a red color with platinum and a dark-brown precipitate with palladium.

Typical assay charges used in the estimation of platinum in different ores.

	Silicate.	Hematite.	Limestone.	Roasted sulphide.	Black sand, largely Fe_3O_4.[a]	Chromite, 40 per cent Cr_2O_3.	Sulphides.	Sulphides with barite.
Ore, assay ton	1	1	1	1	1	1	1	1
Soda, grams	30–60	30	.....	40	.....	.....	30–60	.....
Soda bicarbonate, grams	.....	.....	40	.....	20	60	.....	30
Borax, grams	.....	.....	20	20	.....	.....	10	20
Borax glass, grams	5	8	.....	.....	30	20	.....	.....
Litharge, grams	60–90	70	40	40	66	35	50–150	150
Silica, grams	.....	7	5	4	.....	15	0–10	.....
Fluorspar, grams	.....	.....	.....	.....	.....	.....	.....	15
Argols, grams[b]	2.5	3.5	2.5	7	4	3	.....	.....
Niter, grams[b]	.....	.....	.....	.....	.....	.....	21	8
Silver chloride, grams	.05	.05	.05	.05	.05	.05	.05	.05
Cover	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)

[a] This charge has been used by A. A. Hanks and was kindly furnished by him. He prefers argols to any other reducing agent because in this flux the lead collects better by the use of this reagent.

[b] The quantities of niter or reducer are only approximate and must be so chosen that a 30-gram lead button is obtained.

[c] Borax glass.

ARSENIC.

By V. C. Heikes.

PRODUCTION.

The sales of arsenic in the form of arsenious oxide in 1920 showed a noteworthy increase. They amounted to 11,502 short tons, valued at $2,021,356, and exceeded all former annual sales. In 1919 the sales were 6,029 tons, estimated at $1,181,684 in value. Only 596 tons of the total in 1920 was reported as crude arsenic. The great increase in output was due to the demand of manufacturers of insecticides and weed-killing preparations; about the usual quantity was consumed at glassworks and in manufacturing drugs at chemical works. Some metallic arsenic was reduced from white arsenic, and about 1,800 tons of the sulphide, realgar, was produced at mines to make white arsenic. The white arsenic reported in 1920 was largely a by-product recovered from flue dust and fume at smelters in the Western States. This arsenical dust and fume came from seven smelters, and the output of arsenious oxide came from five arsenic plants. On account of high prices and heavy demand, three of the producers of arsenic made special efforts to obtain ores having a high content of arsenic and to smelt as large a percentage of them as possible with their regular furnace charges.

The table below includes the production of arsenic from all sources from the opening of the first plant at Everett, Wash., in 1901 to the end of 1920.

White arsenic (As_2O_3) produced in the United States, 1901–1920, by periods.[a]

Period.	Quantity (short tons).	Total value.	Average value per pound (cents).
1901–1905	3,054	$173,266	2.837
1906–1910	6,476	408,356	3.153
1911–1915	18,954	1,038,664	2.740
1916–1920	35,991	6,089,540	8.460
	64,475	7,709,826	5.979

[a] Almost all the output was refined white arsenic reported to be above 99.5 per cent of As_2O_3, with the exceptions following: Crude arsenic trioxide containing 97.5 per cent of As_2O_3 reported in 1914, 1915, and 1916 represented 705 tons of the total. In 1920 the crude arsenic trioxide produced was 560 tons and is included in the total for that year. Part of the totals of 1918 and 1919 was metallic arsenic, but the metallic arsenic produced in 1920 was not included as it was reduced from white arsenic purchased on the market.

SOURCES OF PRODUCTION.

As an element contained in ores, arsenic had not been exploited until recent years on account of its troublesome nature in smelting. Even now arsenic is the "bugbear" of the metallurgist, particularly

at lead works, where it is a constant source of expense. It combines with other elements, principally iron, lead, and silver, to form speiss, which, until a short time ago, was considered waste, as no economical method had been found for treating it. Sulphurous gases and fumes containing arsenic from the furnaces caused expensive litigation against smelting companies by the farmers in the immediate vicinity of smelters, and to overcome these nuisances, as well as to save some of the metals that were going to waste, bag houses were built. The first bag house to be used in the United States in connection with lead blast furnaces was erected in 1887 [1] at the Globe Smelting Works, near Denver, Colo., and since that time many other lead plants have been similarly equipped. Next came the electrical precipitation of particles from the fume and gas by the Cottrell treater.[2] This equipment has been effectually used at many lead and copper plants, where the saving of some of the wasted metals is said to offset the expense of its operation and maintenance.

After the arsenical fumes and dust are precipitated they are refined in special furnaces or reverberatories. The refining costs have been low, although transportation charges on material shipped a considerable distance from other smelters and purchases of ores rich in arsenic to increase the arsenic output have added to the total cost of production. Ore producers on a guaranteed basis of quantity were paid as much as 2 cents a pound for ores exceeding 17 per cent of arsenic (As_2O_3), with a corresponding penalty for ores containing less than that percentage. Other producers have had the rate of smelting treatment reduced, but only for ores valuable in other metals. Small plants for direct treatment of arsenical ores have been reported under construction in the States of Nevada, Washington, and New York, and one of the large smelting companies has utilized its old MacDougall roasters in an ingenious way so as to produce arsenic in 1921. Seven smelting plants are known to have contributed to the arsenic output in 1920. Six of them, in addition to those connected with the arsenic plants, were in the Western States and treated various kinds of ore, some of the ore containing considerable arsenic, mined in California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, Alaska, and British Columbia.

The five plants producing the crude and refined trioxide in 1920 were the American Smelting & Refining Co.'s plants at Globe, near Denver, Colo., at Tacoma, Wash., and at Perth Amboy, N. J., the plant of the Anaconda Copper Mining Co., at Anaconda, Mont., and the lead plant of the United States Smelting, Refining & Mining Co., at Midvale, Utah. These five arsenic plants have a total estimated capacity of 18,000 tons of crude and white arsenic annually, but this capacity can not be reached for some time to come unless ores are purchased specially for their content of arsenic. In view of the present large stocks of arsenic on hand, of the prospective smaller demand, and of the reduced smelter operations in the United States, the output of arsenic will probably be less in 1921 than it was in 1920.

[1] Eilers, Anton, Notes on bag filtration plants: Am. Inst. Min. Eng. Trans., vol. 44, p. 708, 1913.

[2] Cottrell, F. G., The electrical precipitation of suspended particles: Jour. Ind. and Eng. Chemistry, vol. 3, p. 542, Aug., 1911. See also Eng. and Min. Jour., vol. 92, p. 763, Oct. 14, 1911; Min. and Sci. Press, vol. 103, p. 255, Aug. 26, 1911; Am. Inst. Min. Eng. Trans., vol. 43, pp. 512, 755, 1912; Met. and Chem. Eng., vol. 10, p. 172, March, 1912; Dunn, E. M., Electrostatic fume precipitation at Anaconda: Am. Inst. Min. Eng. Trans., vol. 49, p. 557, 1914.

Arsenic plants situated near the seaboard have the advantage of those in the interior, and unless other arsenical products, such as insecticides and weed-killing compounds, are made at the interior plants, it may be difficult for them to compete with foreign arsenic in the future.

The American Smelting & Refining Co. reports[3] the output of 17,695,266 pounds of white arsenic in 1920, against 9,359,541 pounds the previous year. Three arsenic plants were operated in 1920 by this company. The Globe plant, near Denver, produced more than 5,000 tons of white arsenic; the plant at Tacoma, Wash., nearly 3,000 tons; and the plant at Perth Amboy, N. J., close to 500 tons. Arsenical bag-house fume and flue dust are treated at these plants from the western lead smelters, situated at Pueblo, Durango, and Leadville, Colo., Omaha, Nebr., East Helena, Mont., and Murray, Utah. The arsenical material from the Murray smelter averaged about 80 per cent As_2O_3 in 1920, and considerably smaller quantities received from the other smelters contained about 40 per cent of As_2O_3. The Globe plant consists of one large double-hearth straight-line calcining furnace for the preliminary treatment of the crude bag-house dust. There are several Godfrey roasters, formerly a part of the smelting plant, which can be utilized if additional capacity is needed. The fumes from the calciner or roasters are condensed in an ordinary flue system, and their final exit is through the bag house, so that there is no escape of arsenical fume. The material recovered here, known as "black dust," which contains about 90 per cent of As_2O_3, is re-treated in a coke-fired refining furnace, of which there are three. Each of these furnaces has a capacity of about 200 tons of refined product per month, or a total of 600 tons, if all run continuously. These furnaces connect with their own flue system, and the circuit is also completed to the bag house. The collected material usually averages 99 per cent or more of As_2O_3, except in the branches of the flue most remote from the furnaces, where a lower-grade product is deposited, which is either re-treated or sold as second-class material when it is in demand. The supply of raw material at the Tacoma plant consists partly of bag-house dust shipped from Murray, Utah, and partly of domestic arsenic-bearing ores which the plant receives, together with speisses from Selby and elsewhere. The arsenic plant proper contains one Godfrey roaster, for the production of black dust, which has its own flue system connected with the general Cottrell plant, and one refining furnace, with a flue system connected with an independent bag house. Its capacity is about 200 tons a month. The raw material at Perth Amboy is chiefly bag-house dust, recovered in connection with the smelting of refinery by-products, with a small proportion accumulated from some Canadian ores. This arsenic plant consists of a calcining furnace, for the treatment of the first dust, and a small refining furnace for the finished product. Each of these furnaces has its own flue system in connection with the Cottrell plant. The refining furnace has a rated capacity of 75 to 100 tons a month, although it has never reached the higher figure for any considerable period. If all three of the plants ran to full capacity, they could probably produce about 900 tons a month, or 10,800 tons a year.

[3] American Smelting & Refining Co. Ann. Rept. for year ending Dec. 31, 1920.

At the lead plant of the United States Smelting, Refining & Mining Co. at Midvale, Utah, not only gold, silver, lead, and copper are recovered from mixed ores, but arsenic and other less common metals are in a large measure saved.

The arsenic plant was originally modeled after the first Anaconda arsenic plant.[4] The furnaces are of the same type. The feed for the arsenic plant[5] is the dust from the bays of the blast-furnace bag house, which are known to contain a large percentage of metallic arsenic. The dust[6] from the blast-furnace section is treated in the arsenic plant, where by two successive volatilizations a high-grade fine white commercial arsenic product is made, analyzing better than 99.5 per cent of As_2O_3. The product is shoveled into buggies and transported by overhead tram to the pulverizing room, where it is barreled or otherwise prepared for market.

The arsenic produced is derived largely from speiss in the furnace products of the Richmond Eureka Co. from Eureka, Nev., and small amounts of arsenic are also obtained from ores.

In 1920 the company reported the production of 2,864,523 pounds of white arsenic, compared with 2,699,643 pounds in 1919. Some metallic arsenic was made in 1919, but none in 1920. In 1920 much of the arsenic produced was used in the manufacture of insecticides and weed killer, and the remainder went to glass and chemical works.

A new department of the company was recently organized at Midvale to manufacture insecticides, fungicides, weed killers, and poison baits, using arsenic in various combinations, and sell them direct to consumers on a jobbing basis. Much arsenic[7] has been made at this plant into sodium arsenite (liquid) for killing weeds on railroad rights of way and on highways in the Salt Lake Valley of Utah and in other States. Calcium arsenate (dust) is made and used for spraying potatoes, dusting alfalfa to kill weevil, and controlling insects that infest truck crops. The prices of refined high-grade white arsenic to dealers on January 1, 1921, are quoted by this company[8] for delivery in carload lots f. o. b. destination at 11.5 to 12 cents a pound and in less than carload lots f. o. b. warehouse points at 12.25 to 22 cents put up in barrels or in as small a quantity as 1-pound sacks. Sodium arsenite is delivered in tank cars, barrels, or pint and larger cans as ordered and ranges in price for car lots from $1.20 to $1.60 a gallon and 25 to 35 cents a pint can. Calcium arsenate is quoted in packages of 250 pounds at 16 cents a pound and in packages containing 4 and 5 pounds at 25 cents a pound.

The new smoke-treatment plant of the Anaconda Copper Mining Co., near Anaconda, Mont., consisting of 20 Cottrell treater units and a special reverberatory furnace, was put into commission in 1919.

Precipitation dust from the main treaters, as well as dust from a stock pile which had accumulated, was smelted, and the copper, silver, gold, and arsenic contained in the dust were recovered.[9] The arsenic refining plant, which was partly completed in 1919, is

[4] Austin, L. S., Washoe plant of the Anaconda Copper Mining Co.: Am. Inst. Min. Eng. Trans., vol. 37, p. 480, 1906.
[5] Elton, James, Arsenic trioxide from flue dust: Am. Inst. Min. Eng. Trans., vol. 46, p. 698, 1914.
[6] Anderson, D. L., Am. Inst. Min. Eng. Trans., vol. 49, p. 575, 1914.
[7] Personal communication from Edgar M. Ledyard, Salt Lake City, Mar. 8, 1921.
[8] United States Smelting, Refining & Mining Co., Agricultural Dept., Edgar M. Ledyard, director, Salt Lake City, Utah, Jan. 21, 1921.
[9] Anaconda Copper Mining Co. Ann. Rept. for year ending Dec. 31, 1919.

capable of producing 300 tons a month of refined arsenic. It refines the crude arsenical dust from the treaters connected with the special reverberatory. Approximately 450 tons a month of crude arsenic for refining is produced, averaging about 75 per cent of As_2O_3, and about 125 tons a month of crude arsenic containing 80 to 90 per cent of As_2O_3 was marketed. At the refinery 80 per cent of the arsenic is recovered. This arsenic plant can produce under favorable conditions 3,000 tons of refined arsenious oxide annually. No arsenic was produced in 1919, but shipments were made from stock on hand. In 1920 the company produced 2,444,347 pounds of crude and refined arsenic. Most of the output was the refined product; of this about 500,000 pounds remained in stock, and of the crude product 20,000 pounds. Of the total Anaconda output about 800,000 pounds was used in making weed killer, over 500,000 pounds in insecticides, and over 500,000 pounds was shipped to other refiners and manufacturers of chemicals and drugs.

PRICES.

The prices of arsenic during 1920, as reported to the Survey by the producers, ranged from 8¾ to 10 cents a pound. These prices, however, were in part reported from works and in part reported from places of sale; those reported from the works are higher than those reported from the places of sale. Consumers report having paid from 7 to 17½ cents a pound, according to quality. The difference in prices may be the result of buying low-grade product or purchasing the higher-grade material in small lots.

The quoted price of white arsenic during 1920, according to the Oil, Paint, and Drug Reporter, ranged from 10¼ cents a pound at the beginning of the year to 18 cents in the middle of June, declined to 13½ cents in August, rallied to 15 cents in September, and then declined to 10½ cents in December. (See fig. 2.) The low price of arsenic that prevailed from 1868 to 1914 is shown in a table of imports of arsenic compounds in Mineral Resources, 1914, Part I, page 961. The prices are sufficiently accurate to permit a general comparison from year to year.

The railroad freight rate on crude or white arsenic from Denver to New York or all points east of the Ohio-Pennsylvania State line at the end of 1920 was $18.86 a ton in barrels or casks for a minimum of 50,000 pounds; the rate from Salt Lake City was $20, and from Seattle or Tacoma $25. The Pacific Mail Steamship Co. and the Matson Navigation Co., which operate freight steamers to Baltimore, furnished a rate on crude and refined arsenic in barrels at 60 cents a hundred pounds in shipments of not less than 60,000 pounds.

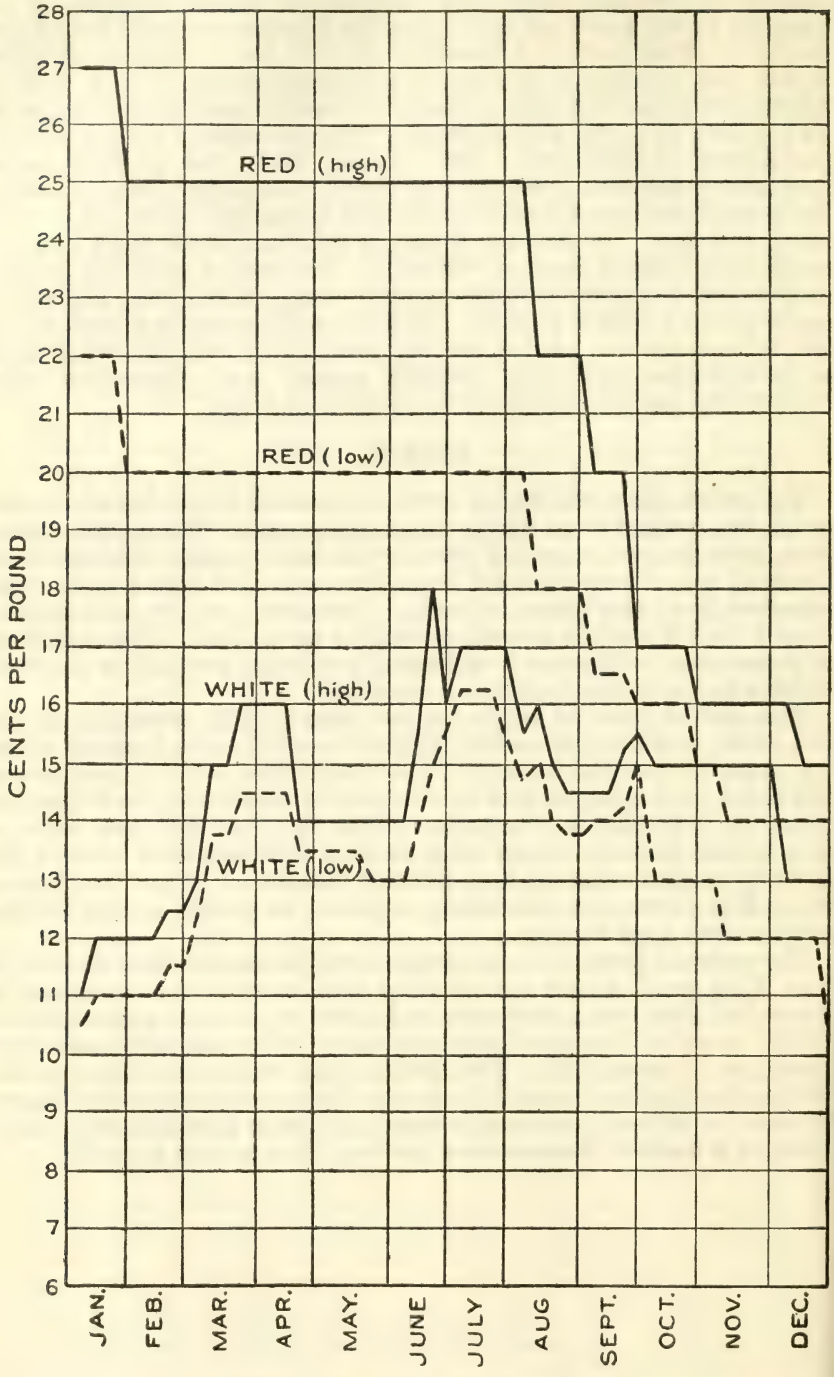

FIGURE 2.—Prices of red and white arsenic, 1920.

IMPORTS AND EXPORTS.[9a]

The imports of white arsenic in 1920 were less than in 1919, but the quantity of "arsenic and sulphide of, or orpiment," increased more than 89 per cent, as is shown by the following table:

Arsenic compounds imported and entered for consumption in the United States, 1909–1920.

Year.	Arsenic or arsenious acid (white arsenic, As_2O_3).		Arsenic and sulphide of, or orpiment.		Sheep dip.		Paris green and London purple.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
1909	445	$31,235	3,591	$272,493	1,574	$9,615	183,765	$20,370
1910	1,348	76,282	3,791	238,024	.....	24,279	181,363	14,648
1911	1,921	116,948	2,175	127,375	.....	20,642	126,191	4,972
1912	3,103	200,616	3,053	228,125	.....	41,556	162,272	6,950
1913	1,519	133,597	3,182	276,849	.....	40,036	99,692	4,431
1914	1,594	109,121	2,034	164,592	.....	34,556	15,476	2,235
1915	1,400	113,677	1,783	154,099	.....	19,916	21,056	4,069
1916	1,071	107,876	1,092	124,818	.....	20,134	23,461	5,028
1917	1,178	264,534	2,777	410,341	.....	15,848	48	189
1918	1,847	441,212	4,842	840,600	.....	23,538	.....	.....
1919	4,389	624,494	2,151	316,687	146,803	12,346	18	14
1920	3,740	532,635	4,080	684,016	70,168	5,150	772	277

Information compiled from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce, shows that the exports of arsenic in 1920 were of little consequence.

Foreign arsenic and sulphide, or orpiment, reexported, 1914–1920.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1914	700	$79	1918	80,050	$12,017
1915	9,776	526	1919	.....	.....
1916	1,761	1,256	1920	13,799	1,827
1917	113,600	15,840			

OCCURRENCE AND DEVELOPMENT.

The minerals containing arsenic, 130 or more in number, were discussed in 1916 by Hess,[10] who also gave the important occurrences and a complete summary of production. For reference to many other localities not mentioned in that report the reader may find Geological Survey Bulletin 624 very useful.

Arsenopyrite is probably more plentiful than all other arsenic minerals. It is found in schists and gneisses and in some places forms deposits in them, which have been worked for their arsenic content, as at Brinton, Floyd County, Va.[11] Veins of arsenopyrite and quartz occur in many places, but only those that carry gold, silver, or other metals in sufficient quantity to make exploration profitable are worked. Such veins were worked under lease in 1919 near Carmel,[12]

[9a] Import and export tables were compiled by J. A. Dorsey, of the U. S. Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

[10] Hess, F. L., U. S. Geol. Survey Mineral Resources, 1914, pt. 1, p. 957, 1916.

[11] Hess, F. L., The arsenic deposits at Brinton, Va.: U. S. Geol. Survey Bull. 470, pp. 205–211, 1911.

[12] Chem. Abstracts, vol. 14, p. 1006, Apr. 10, 1920.

Putnam County, N. Y., and operated in connection with a roaster at Mamaroneck. Hand-picked ore with 21.7 per cent of arsenic and later concentrates with 29.5 per cent of arsenic were roasted in a rotary kiln, gas fuel being used. The fume was passed through a Sturtevant dust collector and thence to a Cottrell precipitator. The unrefined product analyzed 98 per cent of arsenic. No report was received from this source for 1920. At Jardine, Mont., arsenopyrite is the chief source of gold, and as concentrate containing 30 to 45 per cent of arsenic it is treated at the lead smelter near Helena. In the immediate vicinity of the mines the country rock is mica schist, whose character suggests that it has been derived from metamorphosed shales and that the present planes of schistosity follow the original bedding planes. The veins strike north and dip west at angles varying from 20° to nearly vertical, closely conforming to the strike and dip of the inclosing schist. Four principal veins and several minor ones are known. These veins range from a fraction of an inch to 30 feet in width and consist of massive vitreous quartz containing auriferous arsenopyrite and pyrite, the arsenopyrite predominating, with some free gold and in places some scheelite. Knopf [13] mentions arsenopyrite in large quantities in the Minah mine, in the Wickes district, Jefferson County, Mont., and the occurrence of the mineral in ores of mines in the Helena region. The Sultana mines of Grass Valley, Calif., yielded ore carrying 12 to 14 per cent of arsenic, which was treated at Tacoma, Wash. Ore shipped from the Kelly mine at Randsburg, Calif., also carried arsenic. In Nevada, near Battle Mountain, the Irish Rose property is developing into a producer; the ore is largely arsenopyrite and is reported to contain 10 to 40 per cent of arsenic. The ore from the Irish Rose and other properties is being mined for treatment in the arsenic plant under construction at Toulon, 10 miles east of Lovelocks. In the Copper Basin and Lander districts and at Austin, where auriferous arsenopyrite occurs in workable veins, some development work has been carried on. One of the greatest developed sources of arsenic in Nevada, and possibly in the United States, is at Eureka, where some of the earliest smelting operations were begun. The arsenic is contained in a large accumulation of speiss (from the smelting of Ruby Hill ores), estimated [14] in 1888 at 100,000 tons, valued at $1,500,000, principally for its content of gold, silver, and lead. Since 1888 very little of the speiss has been re-treated or shipped, so that the estimate was probably made of the Richmond Co.'s dump, where the speiss was kept separate from the slag; at the Eureka Consolidated Works the speiss was intermixed with the slag. The analysis and assay of the speiss is given [15] as follows: Arsenic 32.95 per cent, antimony 0.13 per cent, sulphur 3.34 per cent, molybdenum 2.31 per cent, lead 2.18 per cent, copper 1.06 per cent, iron 57.02 per cent, zinc 0.07 per cent, lime 0.34 per cent, silica 0.23 per cent, gold and silver 0.029 per cent, or a total of 99.659 per cent. The assay of the speiss was 8.01 ounces of silver and 0.43 ounce of gold per ton. The Ruby Hill Development Co., which leased the dumps in 1920, shipped several thousand tons of the speiss to smelting plants near Salt Lake City.

[13] Knopf, Adolph, Ore deposits of the Helena mining region, Mont.: U. S. Geol. Survey Bull. 527, p. 118, 1913.

[14] Rickard, Thomas, The desilverization of speiss at the Eureka Consolidated Works, Eureka, Nev.: Eng. and Min. Jour., vol. 45, p. 474, June 30, 1888.

[15] Idem, p. 475.

Large veins of arsenopyrite are reported to occur in Skagit County, Wash. North of Monte Cristo and at Monte Cristo,[16] Snohomish County, arsenopyrite forms a large part of the gangue of gold veins. It is reported that the Monte Cristo mine is being reopened. The railroad to this camp has been in very bad condition for several years, and little if any mining has been done in the vicinity of its terminus. In King County, at Miller River, arsenopyrite in ore and concentrate from the Apex mine, shipped in 1920 to Tacoma, averaged 21 to 26 per cent of arsenic, 18 to 20 ounces of silver, 1½ to 2½ ounces of gold, and 4½ to 6 per cent of lead. Payment was made for the arsenic when it exceeded 17 per cent.

The minerals realgar and orpiment are found in many places in the United States, but only one mine produced the ore in any quantity in 1920. The White Caps Mining Co., of Manhattan, Nev., shipped to Tacoma more than 1,000 tons averaging 23 per cent of arsenic and containing some gold. But little ore carrying more than 10 per cent of arsenic is now left in the mine; hence, the development is carried on for gold and indicates about 1 ounce per ton in the primary ore. At the 800-foot level of the mine there is almost a total absence of realgar and orpiment. The primary mineral consists of arsenopyrite, which is found in very minute specks in the silicified zone.[17] Shipments were discontinued on account of high freight rates and the low price paid by the smelting company for the arsenic content. In Snohomish County, Wash., 4 miles north of Reiter, the American Arsenic Co. reports that it produced realgar but made no sales. A 15-ton concentration mill was completed in 1920. Considerable realgar was also developed near Monte Cristo.

Massive bodies of the pale-green ferrous arsenate, scorodite, were reported by Butler[18] as an outcrop in the gossan of the Gold Hill deposit in the Clifton district, Tooele County, Utah, and the ores mined contain oxidation products consisting of hydrous iron oxide and carbonate and arsenates of iron and copper. Most of the ore mined in 1920 by the Western Utah Copper Co. averaged about 12 per cent of arsenic and also carried silver, lead, and some copper. It was shipped to various smelting furnaces. At the 700-foot level the copper and silver content increased in the ore, of which more than 200,000 tons was added to the reserves. Occasional small nodules of arsenopyrite are found at this level.

The North Star mine, at Ketchum, Idaho, has much ore containing arsenopyrite. At Pioche, Nev., the old smelter dumps contain considerable arsenical speiss in slag, of which a number of carloads were shipped in 1920.

WORLD'S PRODUCTION.

The following table shows the world's production by countries. The output of other countries is relatively small compared with that of the United States. Complete figures are not available for some of the countries.

[16] Spurr, J. E., The ore deposits of Monte Cristo, Wash.: U. S. Geol. Survey Twenty-second Ann. Rept. pt. 2, pp. 836–837, 1901.

[17] Personal communication from John G. Kirchen, Tonopah, Nev., Mar. 21, 1921.

[18] Butler, B. S., Ore deposits of Utah: U. S. Geol. Survey Prof. Paper 111, p. 481, 1920.

World's production of arsenic ore and white arsenic, 1913–1920, in metric tons.

Country and kind of ore (where specified).	1913	1914	1915	1916	1917	1918	1919	1920
ORE.								
Australia:								
Queensland (arsenical pyrites)					33	202	(a)	(b)
Western Australia (ore exported)				11	58	708		(b)
Canada	(a)	(a)	(a)	(a)	254	978	481	570
France	4,427	250	1,300	1,800	344	728	600	523
Germany	5,721	4,700	4,100	(b)	(b)	(b)	(b)	(b)
Greece					(a)	(b)	(b)	(b)
Japan	(a)	(a)	(a)			247	968	(b)
Mexico					(a)	(a)	(a)	(a)
Portugal	(a)	(a)	146	(b)	(b)	(b)	(b)	(b)
Rhodesia (southern)		69				103	220	396
Spain (arsenical pyrites)						250	150	(b)
Union of South Africa					(a)	(a)	(a)	(a)
United Kingdom (arsenical pyrites)	36		428	305	441	485	76	(b)
United States	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
China (arsenic trisulphide, exports)	547	115	58	490	310	138	(b)	(b)
WHITE ARSENIC.								
Australia:								
Queensland					d 10	67	e 1,104	(b)
Western Australia				(c)	(c)	(c)		(b)
Canada	1,535	1,576	2,174	1,983	2,409	2,252	2,594	1,661
France		132	323	874	677	993	735	(c)
Germany d	1,892	(c)	(c)	(b)	(b)	(b)	(b)	(b)
Greece					436	(b)	(b)	(b)
Japan	21	15	15			213	835	(b)
Mexico					1,285	1,881	2,246	2,183
Portugal (mostly white)	925	960	859	(b)	(b)	(b)	(b)	(b)
Rhodesia (southern)		(c)				(c)	(c)	(c)
Spain	47	53	83	73	61	104	42	(b)
Union of South Africa					3	16	7	10
United Kingdom	1,722	2,020	2,536	2,586	2,668	2,387	2,568	(b)
United States	2,280	4,237	4,988	5,430	5,580	5,736	5,469	10,434

a White arsenic reported.
b No data available.
c Ore reported.
d Estimated arsenic in ore.
e Figure from Imperial Mineral Resource Bureau, 1,041 tons from Victoria.

Australia.—1920 figures, including 1,025 statute tons (1,041 metric tons) from Victoria, from Imperial Mineral Resource Bureau. Queensland: Annual Report, Under Secretary for Mines. Western Australia: Report of the Department of Mines.
Canada.—1920, preliminary report: Annual Report Department of Mines.
France.—1920, Min. Jour. (London), May 9, 1921: Statistique de l'industrie minérale en France et en Algérie.
Germany.—Vierteljahrsheften zur Statistik des deutschen Reichs; Revista minera, metalúrgica y de ingeniería, Dec. 1, 1920.
Greece.—Tableaux statistiques du mouvement minier.
Japan.—Résumé statistique; Mining industry, Bureau of Mines, Dept. Agr. and Commerce; 1918, figures from English Supplement; 1919, translation from Japanese furnished by consul.
Mexico.—Boletín minero, órgano del Departamento de Minas; 1920, Mapimi smelter, Mines Handbook, vol. 14, p. 1665, 1920.
Portugal.—Imperial Mineral Resource Bureau.
Rhodesia (southern).—1920, Min. Jour. (London), May 9, 1921, Report of the Secretary for Mines.
Spain.—Estadística minera.
Union of South Africa.—1920, Min. Jour. (London), May 9, 1921; Ann. Repts., Dept. Mines and Industries.
United Kingdom.—Mines and Quarries Report, pt. 3.
China.—Imperial Mineral Resource Bureau.

USES.

Most of the arsenic produced in 1920 was used by manufacturers of insecticides, and its use increased not only in arsenic compounds as weed killers, particularly on the Hawaiian sugar and pineapple plantations, but also in calcium arsenate employed in the fight against the boll weevil[19] in the cotton States. It is a substitute for lead arsenate on account of the cheapness of lime as compared with lead oxide, and more recently a very considerable output has been

[19] A method of preparing a commercial grade of calcium arsenate: U. S. Dept. Agr. Bull. 750, Oct. 5, 1918. Recent experimental work on poisoning cotton-boll weevils: U. S. Dept. Agr. Bull. 731, July 19, 1918.

absorbed by some of the railroads as a weed killer on their roads. Municipalities have also consumed large quantities of sodium arsenite for the same purpose.

Experiments have been made[20] with certain toxic gases, particularly arsine or arseniureted hydrogen, for use in fumigation. Calcium arsenate can be easily prepared[21] by slaking lime with a solution of sodium arsenate. Others[22] have recommended calcium arsenate prepared by the action of soluble lime salts on sodium arsenate. In all these processes soluble by-products are formed. Chemically, means of producing calcium arsenate is the direct union of calcium hydroxide and arsenic acid.

Arsenic enters into the composition of plate glass and in France into that of enamels.[23] The tanners use the white oxide as an antiseptic for preserving hides, and occasional use is made of the sulphide as a depilatory on hides. White arsenic is also employed in pyrotechny, in printing calico, and in pigments, vermicides, and drugs. During the war arsenic was used for making chilled shot instead of antimony, which was for a time very scarce. Its alloys with copper are white, dense, malleable, and fusible. Speculum metal and some Britannia metal are found to contain it. The use of arsenic as a flux in brass is advocated,[24] as it is the one element which approaches nearest the action of a flux, because it promotes the union of metals that would be difficult to mix.

Arsenic has been added to the manufacture of steel, and tests[25] show a slight superiority in favor of the steel containing arsenic.

FOREIGN PRODUCTION.

The arsenic producers of Mexico and Canada, being in closer proximity to the eastern seaboard markets than those at interior points of the United States, are the chief competitors in our arsenic industry and no doubt will be able to supply the market cheaply and in large quantities.

UNITED KINGDOM.

The arsenical ores[26] of Great Britain are found chiefly in Devon and Cornwall. During the World War the production became very large, and the price rose from $43.80 to $267.65 a ton in 1917 and to about $500 later. Because of this great rise in price arsenic refineries were constructed by the two mining companies at South Crofty and East Pool, Cornwall, and many of the mines in both Cornwall and Devon are now (1920)[27] producing large quantities of arsenic. At all these localities the country rock is either granite or the altered "killas" or igneous rocks. Parts of the report descriptive of the lodes follow:

> The lodes generally range a little north of east and south of west roughly parallel with the trend of Cornwall and of that of several granite masses. * * * Each group of these lodes contains an assemblage of minerals that is peculiar to it in respect of the relative proportions between the component minerals. * * * Mixed sulphide

[20] U. S. Dept. Agr. Bull. 893, Sept. 8, 1920.
[21] U. S. Dept. Agr. Bull. 750, Oct. 5, 1918.
[22] Oregon Agr. Exper. Sta. Bull. 131.
[23] Pitavel et Ganet, Traité général du commerce des minerais et métaux, 1918, p. 963.
[24] Holder, G. C., Use of arsenic in brass with formulas: Metal Industry, vol. 17, p. 124, March, 1919.
[25] McKinney, P. E. (chemist and metallurgist, Naval Gun Factory), Effect of arsenic in steel: Chem. and Met. Eng., vol. 23, p. 294, Aug. 18, 1920.
[26] Dewey, Henry, Arsenic and antimony ores: Special reports on mineral resources of Great Britain, vol. 15, Geol. Survey, 1919.
[27] Commerce Repts., 1920.

ores (chalcopyrites, pyrites, etc.) in association with arsenic (mispickel) and tungstates (wolfram and scheelite) and cassiterite appear to occur more frequently. * * * At South Crofty the arsenical ore comes mainly from above the 200-fathom level. It is almost confined to the copper zone and is intimately associated with tungsten ore. It is a miners' axiom that "where tungsten is found there also will arsenic be."

AUSTRALIA.

Queensland.—At Jibbinbar, near Stanthorpe, in the southeast corner of Queensland, a Government-owned arsenic mine and plant began operations and was producing 10 tons of arsenic weekly in 1919.[28] It is briefly described in a recent article[29] as follows:

The ore body at the State arsenic mine is very large. At the 209-foot level it has increased in width from 5 feet to 12 feet at the bottom, where the average * * * is 22 per cent. * * * The whole of the arsenic produced has been distributed. The mines department proposes to add to its plant at the mine and hopes thereby to be able to supply all requirements. * * * The mine is now yielding arsenic from the lower-grade ore, which, on being put through the furnaces, has averaged 11 per cent of arsenic, and during the last 10 days of January produced something like 28 tons. Hitherto the consumption of arsenic has, owing to the high price ruling for the product, been less than 60 tons per month, but the minister anticipates that constantly increasing quantities will be used in Queensland if the price can be kept down to £20 per ton, and that the demand for the commodity, particularly for prickly-pear destruction, for which purpose it is being supplied by the Government at £10 per ton, will become very great.

In the Kobble Creek district of Queensland is another deposit known as the Arsenic lode, the commercial possibilities of which are reported[30] to be small. There are arsenic mines also at Gore,[31] in the Stanthorpe mineral field.

CANADA.

The production[32] of arsenic in Canada includes arsenious oxide, refined and crude, produced in the smelting of the arsenical silver-cobalt-nickel ores of the Cobalt district; in addition to which arsenic has been recovered at Tacoma, Wash., from the arsenical gold concentrates shipped from the Hedley gold mine at Hedley, British Columbia.

The annual report of the Canada Department of Mines contains the following table:

Production, exports, and imports of arsenic in Canada, 1916–1920.

	1916		1917		1918		1919		1920	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Production:	*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
From arsenical concentrates.	.....	.....	280	$11,200	1,078	$43,114	530	$21,218	628	$22,231
White arsenic..	2,186	$262,340	2,656	658,231	2,482	520,525	2,859	488,706	1,831	425,617
Exports:										
White arsenic..	1,975	197,458	4,286	507,898	2,672	393,883	2,506	355,654	1,655	313,311
Imports:	*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*	
White arsenic..	41,090	7,086	247,610	32,083	995	222	4,706	1,325	962	201
Sulphide of arsenic.....	239,991	11,839	252,848	22,053	301,985	33,351	304,694	26,613	307,153	43,445
Arseniate of soda [a].....	15,779	1,228	4,469	588	121	34	5,566	1,661	48,863	10,568

[a] Includes biarseniate and stannate of soda.

[28] U. S. consul, New Castle, Australia, Nov. 22, 1919. State arsenic mine, Jibbinbar, Queensland, Australia: Queensland Govt. Min. Jour., vol. 21, No. 236, pp. 3–4, Jan. 15, 1920.

[29] Abstract from Queensland Government Mining Journal: Eng. and Min. Jour., vol. 109, p. 991, Apr. 24, 1920.

[30] Saint-Smith, E. C., Arsenic lode, Kobble Creek district: Queensland Govt. Min. Jour., vol. 21, No. 237, p. 56, Feb. 14, 1920.

[31] Arsenical mines near Gore: Queensland Govt. Min. Jour., vol. 20, No. 234, p. 464, Nov. 15, 1919.

[32] Mineral production of Canada: Canada Dept. Mines Ann. Rept., 1919, No. 545, p. 50, Ottawa, 1920.

In the southern part of Ontario [33] four reduction works operate on silver ore and concentrate from Cobalt. At the Deloro works [34] the products from smelting are speiss, slag, and arsenic fume collected in bag houses of the regular type. The speiss contains 22 to 25 per cent of cobalt, 16 to 18 per cent of nickel, 25 per cent of arsenic, 18 per cent of iron, 7 per cent of sulphur, 1 per cent of copper, and 1,000 to 1,200 ounces of silver per ton. Further information from the article follows:

This speiss product is ground in a ball mill until the whole passes a 40-mesh screen. The ground material is then roasted until it contains only 10 per cent of arsenic. The roasting is done in a furnace of the reverberatory type equipped with a mechanical rabble having water-cooled arms. The chloridizing is done in a Bruckner cylinder.

The chloridized speiss is washed with water and then agitated for one hour with a cyanide solution containing the equivalent of 20 pounds of KCN per ton. The silver is precipitated from the solution by means of aluminum dust. * * *

The precipitate now goes to the silver refinery and the desilverized speiss residues to the oxide plant. * * *

The gases from the blast furnaces, the roasters, and chloridizers are drawn through flues and coolers before reaching the bag houses, which collect the crude arsenious oxide. * * *

The crude arsenic collected in the bag houses is sent to refining furnaces, which are coke-fired reverberatory hearths. The arsenious oxide is volatilized and condensed in chambers that are emptied at intervals of 10 to 14 days. The products from these chambers are pulverized and packed in barrels by means of a Raymond pulverizer. * * *

The crude and white arsenic [35] produced in Ontario in 1919 was 2,834 short tons, valued at $485,360. Arsenic was first reported as a constituent of ores mined at Cobalt in 1904, when the mines were first opened. Prior to 1914 an estimate was made of the nickel, cobalt, and arsenic contents, and since that time the actual recoveries of these elements have been taken into consideration. The first production from British Columbia was reported [36] from the Nickel Plate mine of the Hedley Gold Mining Co. and amounted in 1917 to $11,200, in 1918 to $43,114, and in 1919 to $21,218. The arsenic occurs in arsenical iron pyrites in the concentrates shipped to the smelter at Tacoma, Wash. These concentrates had been going to that smelter for years, but until the recent installation of an arsenic plant the arsenic content was not recovered.

At Bush Mountain, in the Nelson mining district, a large deposit of orpiment ore, reported [37] to carry 20 per cent of arsenic, was discovered in 1919. Native arsenic [38] associated with calcite is found on Alder Island.

MEXICO.

The Mapimi smelter, Mexico, operated by the Compañía minera de Peñoles, owned by the American Metal Co. (Ltd.), made an important output of arsenic in 1920. This plant is rated [39] to produce under normal conditions 5,000 tons of white arsenic annually.

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[33] Ontario Dept. Mines Twenty-ninth Ann. Rept., for 1920, pt. 1, 1920.

[34] The smelting and refining of cobalt ore (abstracted from Canadian Min. Inst. Bull. Dec., 1918); Min. and Sci. Press, vol. 118, p. 125, Jan. 25, 1919.

[35] Ontario Dept. Mines Ann. Rept., for 1920, p. 14, gives a table of the output of arsenic, 1904–1919.

[36] Min. Mines Ann. Rept., 1917, Victoria, B. C.; Mineral production of British Columbia, p. 27, 1918. Values taken from Ann. Rept. Dept. Mines; McLeish, John, Mineral production of Canada for 1919, p. 50, 1920.

[37] Consul Norton F. Brand, Fernie, B. C., Oct. 10, 1919.

[38] Native arsenic in British Columbia, Canada: Chem. Jour., vol. 4, No. 10, p. 268, Oct., 1920.

[39] Mines Handbook, vol. 14, p. 1665, 1920.

JAPAN.

Commercial arsenic is produced in Japan. According to Commerce Reports [40] the total production of arsenious oxide was 877,651 pounds in 1918 and 2,862,653 pounds in 1919. Its exact value was unobtainable but may be estimated from the declared export returns of consulates in Japan, excluding Taiwan and Dairen. The total exports to the United States in 1919 are given as 1,821,340 pounds, valued at $70,739, of which 1,387,388 pounds, valued at $48,337, came from Yokohama. The total exports from Yokohama to the United States during the first seven months of 1920 are stated as 1,102,020 pounds, valued at $39,510. Deposits of arsenical ore containing 15 to 30 per cent of arsenic occur in the Prefectures of Oita, Miyazaki, Hiroshima, Hyogo, Shimane, and Okayama. In 1918 914 tons of ore was produced, valued at $9,204, against 1.067 tons in 1919, valued at $6,975. This did not include ore used at the mines by companies for producing arsenious oxide. In continuation Vice Consul H. T. Goodier says:

Arsenious acid is produced in Japan by direct reduction of arsenic ore and also as a by-product in copper and lead smelting. The former method has been used on a small scale for the last 10 years, but only quite recently have by-product methods been installed by certain copper and lead mining companies in endeavors to consume poisonous gases, etc., from smelting operations.

Under the direct method of producing arsenious "acid" one company is said to have a capacity of about 3,333 pounds at a firing. The charge is renewed about 20 times a month. From ore of 20 per cent arsenic the output of one furnace will make approximately 13,333 pounds of crude arsenic each month.

About 20 per cent is lost in refining.

The three largest manufacturers of arsenious acid in Japan are said to approximate a monthly output of 70 tons (crude only), 30 and 15 tons (both refined), respectively.

The arsenic content of acid thus produced by both methods is, roughly, 95 per cent in the crude and about 97 to 99 per cent in the refined.

If the industry is given adequate support by large companies, it is claimed that 4,000 tons of acid per year can be produced from known sources.

Imports and exports—Certificates of analysis.—There are no imports of this "acid" into Japan, so far as known.

As the acid is used in Japan only in the preparation of a few medicines, in the manufacture of insecticides on small scale, and occasionally for wall-paper coloring, etc., the greater part of the annual production is available for export—largely to the United States, Great Britain, Australia, and a little to the Philippine Islands. As the Japanese Government export returns do not list arsenious acid separately, it is impossible to state the small amounts going to countries other than the United States.

It is stated that arsenious acid for export must always have a certificate of analysis by a public chemical laboratory attached to the export documents of each shipment. Analysis of crude acid by one copper-mine laboratory shows the following composition.

	Per cent.
Arsenic (by distillation)	96.79
Iron oxide	.39
Sulphur anhydride	1.11
Zinc	.21
Lead	.26
Antimony	.04
Selenium and tellurium	.03
Moisture	.40
Others	.77
	100.00

[40] Arsenic industry in Japan: Commerce Repts., Oct. 27, 1920, p. 444.

Test for purity.—The following test for purity, as given by this laboratory, is said be the usual one adopted by chemical laboratories in Japan:

Five-tenths of a gram of arsenious acid is boiled to a solution in a little water with 3 ams of bicarbonate of sodium. The solution is then allowed to cool and is diluted th water up to a total volume of 100 cubic centimeters. From this 10 cubic centi-ters of solution is drawn off into a test tube and shaken. An ordinary iodine solu-n is then added drop by drop until the "fading" action of the iodine upon the ginal solution becomes rather neutral. A few drops of starch paste is then added d a few more drops of the iodine solution are poured in until the whole reaches a t blue color. The quantity of iodine solution required, multiplied by 0.00495, es the net content of arsenic.

Prices and freight rates.—Current prices for arsenious acid are stated to be $9.47 o. b. Kobe final) per 112 pounds refined white, 99 per cent pure; and $8 (c. i. f. attle) per 100 pounds crude, 95 per cent pure.

Obtainable freight rates on Japanese lines that will quote are:

Nippon Yusen Kaisha:	
From Yokohama—	
To Seattle, per 2,000 pounds	$13.50
To New York via the Panama Canal, per 2,000 pounds	37.50
Toyo Kisen Kaisha:	
From Yokohama to San Francisco, per 2,000 pounds	13.50

The smelting concerns in Japan treating copper and lead ores were mpelled by the agricultural interests to adopt methods to guard ainst injury to vegetation. Eight Cottrell treaters were installed 1918 and 1919, having a total of 1,984 pipes. A recent announce-nt [41] credits the Ashio copper plant with saving 13,000 to 22,000 unds of precipitation dust in 24 hours, containing an average of 83 per cent of arsenic; the Kamioka and Naoshima lead plants, 00 to 3,300 pounds of dust with 19.65 and 13.43 per cent of arsenic spectively; and the Ikuno lead plant, 1,350 pounds of dust averag-32.39 per cent of arsenic.

TURKEY IN ASIA.

Arsenic has been discovered [42] in Asia Minor, Smyrna, but up to e no mining concessions have been granted.

[41] Hirota, Ritaro, and Shiga, Kyoshi, Cottrell electrical precipitation process in Japan; Eng. and Min. , vol. 108, pp. 895–899, Dec. 13 and 20, 1919.

[42] American consul, Smyrna, Syria, Commerce and Industry for 1919, Sept. 30, 1920.

BISMUTH.

By Victor C. Heikes.

PRODUCTION.

The output of domestic bismuth in 1920 is known to have been much smaller than in 1919, but no figures can be given, as the producers object to having their output published. Metallic bismuth produced in 1920 was estimated [1] recently at 320,000 pounds, compared with 250,000 pounds in 1919, but later reports from producers do not verify this increase. Lead and tin refiners, of which only a few in the United States save bismuth as a by-product, reported a considerable quantity of bismuth residue which has not found a market and which is considered worthless by one firm having a large accumulation of it. Some bismuth has been obtained from blister copper, as stated by Hess,[2] who believes that eventually it may be recovered from the flue dust of copper furnaces also.

Fume containing lead and bismuth is recovered in Cottrell treaters at some copper plants. In 1920 a considerable amount of fume was re-treated at western lead smelting works. Other sources of bismuth are the crude lead and copper ores containing bismuth sold principally for the precious-metal content. The ore buyer frequently pays for all the bismuth at 50 cents to $1.25 a pound for 3 per cent or more and for 75 per cent of the other metals contained in the ore at market prices. Only a small percentage of the original bismuth contained in the ores going to the lead smelter is recovered in the lead bullion.

During 1920 the Sells mine at Alta, Utah, produced ore containing 8,517 pounds of bismuth, part of which, with the silver and copper in the ore, was paid for by the smelting company. Most of the bismuth ore was oxidized, but several lots of rich sulphide ore were shipped. Butler [3] reported that a sample of the sulphide ore contained 26.92 per cent of bismuth as well as copper, sulphur, and small quantities of lead, arsenic, antimony, iron, and zinc. Other sources of bismuth ore in 1920 were Eureka and Pioche, Nev., and the Silver district, Yuma County, Ariz. The United States Smelting, Refining & Mining Co. recovers annually considerable bismuth at its refineries for base lead bullion. According to the annual report of this company for 1919 it acquired full ownership of the electrolytic lead refinery (sometimes called Grasselli refinery) at East Chicago, Ind., for the treatment of lead bullion from the company's western operations. This plant is now operated through a new subsidiary company called U. S. S. Lead Refinery (Inc.). Lead bullion, drosses, and other custom metals amounting to 33,637 tons were treated in 1919. By-products such as bismuth, antimony, and hydrofluoric acid

[1] Eng. and Min. Jour., vol. 111, p. 150, Jan. 22, 1921.
[2] Hess, F. L., U. S. Geol. Survey Mineral Resources, 1913, pt. 1, p. 287, 1914. See also Eilers, Anton, Am. Inst. Min. Eng. Trans., vol. 47, p. 217, 1914.
[3] Butler, B. S., personal communication Apr. 12, 1920.

are said to have contributed substantially to the profits derived from the plant. The Betts process is used at this plant and perfected by William Thum,[4] who developed the process to recover bismuth, tellurium, and antimony as by-products in the electrolytic refining of lead. Mr. Thum took out a number of patents, one of which was for the separation of bismuth from copper. The company also owns the rights (U. S. patent No. 1360271) to a process for the extraction of bismuth from ore by leaching with brine containing an acid. A solution of the bismuth salt is formed by the acid, and the bismuth is precipitated from solution. Another possible source of bismuth is the new electrolytic plant erected for the production of white lead at East Chicago, Ind., built in 1919 by the Anaconda Lead Products Co.[5]

IMPORTS.

Bismuth imported for consumption in the United States, 1913–1920.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1913	117,747	$213,257	1917	69,250	$142,300
1914	90,505	165,208	1918	135,700	277,273
1915	44,362	108,288	1919	57,607	55,179
1916	76,723	195,975	1920	72,771	161,877

EXPORTS.

No exports of bismuth are recorded.

FOREIGN PRODUCTION.

Bismuth is produced abroad principally in England, Australia, and Germany from ores mined in Bolivia, China, Australia, Peru, Mexico, and Saxony. Norway, Spain, Chile, and Hungary have also produced bismuth. The principal features of the industry in 1920 were the comparatively heavy shipments of bismuth ores produced in China as a by-product in tungsten mining, and the Australian shipments. Exports of mineral products from the Potosi district of Bolivia [7] show 18,360 kilos (40,392 pounds) of bismuth. Important tin, silver, and bismuth mines in southern Bolivia near Atocha are controlled by the Aramayo Francke Mines (Ltd.) and operated by the Anglo-Bolivian Mining Syndicate (Ltd.). This company is said to stand third in importance in the mining affairs of the district. Bismuth ores [8] exported from Hongkong to the United States the first eight months in 1920 amounted to 7,014 pounds, against 11,544 pounds during the same period in 1919.

PRICES.

The price [9] of bismuth in 1920 for 500-pound lots was quoted at $2.65 a pound the first half of January, continued at $2.50 until April, remained steady at $2.70 until the later part of September,

[4] Eng. and Min. Jour., vol. 108, p. 108, July 19, 1919.
[5] Anaconda Copper Mining Co. Ann. Rept. for year ending Dec. 31, 1919.
[7] Mining activities in the Potosi district in Bolivia: Eng. and Min. Jour., vol. 110, p. 1176, Dec. 18, 1920.
[8] American consul, Hongkong, China, declared exports from Hongkong to the United States, Sept. 13, 1920.
[9] Metal quotations: Eng. and Min. Jour., vol. 110, 1920.

dropped to $2.55 during October and November, and closed at $2.40 in December. Bismuth is believed to bring a high price on account of the demand for it and not on account of the cost of production. The output is largely controlled by British interests. The chief buyer of bismuth is the firm of Johnson, Matthey & Co. (Inc.), a London firm with offices in New York City. Quotations in London remained unchanged during 1920 at 12 shillings 6 pence a pound. According to J. A. Samuel,[10] of Philipp Bros. (Inc.), refiners of tin-bearing material, large stocks of bismuth are held abroad, and it is not improbable that the price may recede. Stocks of unsold Australian bismuth are also held in New York.

USES.

Bismuth is used chiefly for pharmaceutical purposes. It must be 99.9 per cent pure and contain no arsenic. The principal bismuth salts manufactured are known as bismuth subcarbonate, nitrate, gallate, subgallate, and salicylate. The low melting point (260°) of bismuth makes it valuable in the fusible alloys. It possesses the special property of expanding on cooling and forming alloys of exceptionally low melting point. Further uses of bismuth were given in detail in Mineral Resources for 1917, Part I, page 29.

[10] Eng. and Min. Jour., vol. 111, p. 150, Jan. 22, 1921.

SELENIUM AND TELLURIUM.

By Victor C. Heikes.

SELENIUM.

The output of selenium in 1920 was 92,141 pounds, valued at 175,508, compared with 60,025 pounds, valued at approximately 125,966, in 1919. A large part of the selenium produced in 1920 was used at glass works, and little of it remained in stock, according to the reports of the producers. Most of the selenium is a by-product in the electrolytic copper refineries,[1] where it is obtained from the anode mud, which is fused with sodium nitrate and sand. The producing companies reporting in 1920 were the American Smelting & Refining Co., the Raritan Copper Works, and the United States Smelting, Refining & Mining Co. Increased inquiry for selenium suggests a larger production in future, as its use is probably increasing. Victor Lenher,[2] in a review of results accomplished by the National Research Council, says that the copper refineries can supply at present 300,000 pounds of selenium and 125,000 pounds of tellurium a year without materially altering their plants. During the World War selenium was used for the decolorization of glass when manganese was scarce. It has the greatest use in giving a red color to glass such as that used for signal lights on railroads and in producing a red coloring for enameled ware. It is also used to overcome the natural green color of ordinary glass. Selenium is peculiar in being a very poor conductor of electricity in the dark and a fairly good conductor in the light, and it is used in several electrical devices whose utility depends on this peculiarity. It has been used in telephoning along a ray of light and in transmitting sounds and pictures from one place to another over a wire. The element is employed either in the form of a black amorphous powder carrying 99 per cent of selenium or as sodium selenite. According to Victor Lenher,[3] its use in the form of selenium oxychloride has great possibilities to the chemist as an excellent solvent for unsaturated organic substances. The unsaturated hydrocarbons and aromatic hydrocarbons dissolve readily in the solvent, whereas the paraffin hydrocarbons do not. Bakelite, redmanol, the waterproof insoluble casein glue used in airplane construction, pure rubber, vulcanized rubber, asphalt, and bitumen dissolve with ease. The bituminous material can be dissolved from soft coal, leaving a carbonaceous residue. Workable quantities of selenium and tellurium for use in research will be furnished at cost price by the producing companies, and E. W. Rouse, of the Baltimore Copper Smelting & Rolling Co., Baltimore, Md., will ship at any time reasonable quantities of selenium gratis to

[1] A summary of published information concerning the occurrence of selenium in blister copper and in various ores is recorded by F. L. Hess in U. S. Geol. Survey Mineral Resources, 1914, pt. 1, pp. 971–972, 916.

[2] Selenium and tellurium: Chem. and Met. Eng., vol. 22, p. 1108, June 16, 1920.

[3] National Research Council: Chem. and Met. Eng., vol. 22, p. 773, Apr. 28, 1920.

investigators upon the recomendation of the committee on the uses of selenium and tellurium of the National Research Council. Arthur E. Hall, of the Omaha plant of the American Smelting & Refining Co., will forward reasonable quantities of tellurium gratis under the same conditions.

PRICES.

Selenium ranged in price [4] from $1.75 to $2 a pound until August and then from $2 to $2.25 to the end of 1920.

IMPORTS.

Selenium and selenium salts imported for consumption in the United States, 1913–1920.

1913	$320	1917	$2,236
1914	43	1918	0
1915	59	1919	25,866
1916	302	1920	0

TELLURIUM.

Tellurium in the form of metal was produced in 1920 at the Raritan Copper Works, Perth Amboy, N. J. The company has a stock of the metal and oxide on hand and finds no demand for the element except for use in experiments. Tellurium has been used in a small way in high-resistance alloys, for coloring porcelain and glass, for staining silver, in medicine, and in the manufacture of certain special dyes.

It is understood that tellurium could be produced in very much larger quantities than selenium, but the output depends on some new use for it.

[4] Eng. and Min. Jour., 1920.

ANTIMONY.

By Frank C. Schrader.

THE ANTIMONY SITUATION.

As this report is issued very soon after that for 1919, and as the antimony industry has recently undergone no appreciable change, the report is abbreviated to but little more than the usual statistical tables and curves. For a general discussion of the subject the reader is referred to the report for 1919.

The average quoted price of antimony in 1920 was 8.49 cents a pound; in 1919 it was 8.19 cents. From the strong opening at 9.75 cents in January the price steadily advanced to 11⅝ cents in February and remained there until early in March, when, owing to large imports, it began a decline that in general continued almost steadily through the rest of the year. Heavy offerings of war scrap and shrapnel by several Governments in September and October sent the price down, and in December it fell to 5½ cents, the lowest price recorded for antimony in more than six years and a decline from the beginning of the year of more than 43 per cent.

USES.

Metallic antimony is used chiefly in alloys with other metals, as in type metal, babbitt or bearing metal, Britannia or white metal, and antimonial or hard lead. The antimony oxides are used for making white enamel and the oxides and sulphides as coloring agents and paint pigments.

DOMESTIC PRODUCTION.

The United States in 1915–1918 produced 10,750 short tons of antimony ore containing 4,310 tons of metal. There has been no production of ore since 1918.

Metallic antimony produced at smelters in the United States, 1917–1920, in short tons.

Year.	From domestic ores.	From foreign ores.
1917	258	2,182
1918	127	2,490
1919	(a)	(a)
1920	(b)	(b)

a A small quantity was produced by two smelters, but the Survey is not at liberty to publish the figures.
b A small quantity was produced by one smelter, but the Survey is not at liberty to publish the figures.

SMELTER PRODUCTION OF ANTIMONIAL LEAD.

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1916–1920.

Year.	Quantity (short tons).	Antimony content (short tons).	Value of antimony content.[a]
1916	24,038	3,496	$1,775,968
1917	18,646	2,759	1,142,226
1918	18,570	2,566	646,632
1919	13,874	1,943	318,652
1920	12,535	2,033	345,203

[a] Calculated on basis of average yearly price.

RECOVERY OF SECONDARY ANTIMONY.

During 1920, 5,600 short tons of antimony was recovered from old alloys, scrap, and dross. Practically all of this was recovered in the form of alloys, not as metallic antimony.

Antimony content of secondary alloys recovered from old alloys, scrap, and dross, 1916–1920.

Year.	Quantity (short tons.)	Value.[a]
1916	4,480	$2,270,016
1917	4,961	2,061,700
1918	5,226	1,317,000
1919	4,399	717,900
1920	5,600	938,560

[a] Values calculated at average yearly price for ordinary brands of antimony.

IMPORTS.

The accompanying statistics of imports are compiled from the records of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce. The imports are reported as (1) imports for consumption, including merchandise entered for immediate consumption or withdrawn from bonded warehouses for consumption, and (2) total or general imports. Only general imports are listed by countries of origin.

Antimony imported and entered for consumption in the United States, 1916–1920.

Year.	Antimony ore.[a]			Liquated antimony sulphide.[b]		Metallic antimony.[c]		Antimony oxides and other compounds.[d]	
	Quantity (short tons).	Antimony content (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1916	7,840	4,622	$1,072,340	.....	.....	7,064	$3,548,507	213	$109,832
1917	10,083	5,832	1,006,884	796	$128,660	11,286	2,829,159	10	5,388
1918	3,363	1,425	177,731	833	113,258	14,011	3,065,619	18	11,904
1919	993	409	54,477	278	19,202	7,159	1,021,587	126	9,561
1920	1,709	682	70,285	1,375	123,902	9,817	1,216,376	298	25,260

[a] Classified in tariff classification as "Antimony ore and stibnite containing antimony."
[b] Classified in tariff classification as "Antimony matte, containing not more than 10 per cent of lead."
[c] Classified in tariff classification as "Antimony regulus or metal."
[d] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."

Imports [a] of antimony into the United States in 1919–1920.

[General imports.]

Country.	Antimony ore.			Antimony metal.[b]	
	Quantity (short tons).	Antimony content.		Quantity (pounds).	Value.
		Quantity (pounds).	Value.		
1919.					
ngland				90,048	$8,803
nada				2,308,880	167,764
nama	2	1,200	$99		
xico	297	219,048	11,332	757,076	60,571
wfoundland		28	10		
ile [c]	47	49,624	6,312		
ru	74	90,726	7,345		
ina [d]	455	362,326	23,936	7,847,840	459,613
itish India				224,000	10,976
ngkong [d]	4	4,510	493	68,320	3,949
pan [d]				2,953,994	159,091
	879	727,462	49,527	14,250,158	870,767
1920.					
gland				125,539	14,638
ance	467	315,861	10,605		
nada	132	19,457	2,179	225,272	19,111
nama	65	80,293	3,856		
livia	388	335,061	22,941		
ile [c]	162	152,276	11,963		
ina [d]	420	450,293	14,185	21,564,851	1,218,802
ngkong [d]	75	10,200	4,556	706,156	44,909
pan [d]				2,325,303	177,816
	1,709	1,363,441	70,285	24,947,121	1,475,276

[a] Includes large quantities of antimony metal that went into bonded warehouse and that are not included in the table of imports for consumption.
[b] Includes small quantities of liquated antimony sulphide, known in the trade as "crude antimony," "antimony matte," or "needle antimony."
[c] Imports credited to Chile originated mainly in Bolivia.
[d] Nearly all the imports of antimony ore and metal from Hongkong and Japan are of Chinese origin. Some of the material credited to other countries is possibly also of Chinese origin, having been transshipped through a foreign port.

The general imports showed an increase of about 76 per cent in quantity and 68 per cent in value in 1920, as compared with 1919. Imports of ore nearly doubled. The ore came mostly from France, China, Bolivia, Chile, and Canada. Imports of metal increased 75 per cent, owing largely to increased shipments from China and England; those from China increased 175 per cent.

As shown in Plate I, the imports reached their maximum of about 800,000 pounds in March and their minimum of 426,000 pounds in November. The most marked increase was that from 2,800,000 pounds in February to 4,800,000 pounds in March, and it was followed by the sharpest decrease, to about 2,081,000 pounds in April. In December they amounted to 1,895,262 pounds—about 800,000 pounds more than in December, 1919.

Large quantities of antimonial lead are imported into the United States as type metal.

Type metal imported and entered for consumption, 1916–1920.

Year.	Type metal.		Assumed antimony content.	
	Quantity (short tons).	Value.	Quantity (short tons).	Percentage.
1916	581	$83,816	119	20.5
1917	None.		None.	
1918	276	35,938	19	6.9
1919	6,697	816,642	1,197	17.9
1920	14,944	1,349,495	2,063	13.8

EXPORTS.

Foreign antimony exported from the United States, 1916–1920.[a]

Year.	Ore.			Matte, regulus, or metal.	
	Quantity (short tons).	Antimony content (pounds).	Value.	Quantity (pounds).	Value.
1916	231	255,695	$9,874	3,018,251	$761,045
1917				989,477	169,260
1918				1,410,970	164,666
1919	3	5,380	1,665	429,059	33,913
1920				896,034	51,607

[a] Exports go mainly to Canada.

STOCKS.

The metallic antimony in bond December 31, 1919, as reported by the Bureau of Foreign and Domestic Commerce, was 2,402,520 pounds. By the end of February it decreased to 2,213,951 pounds. From this date on it increased to 4,303,413 pounds, the maximum of the year, by the end of July, and then decreased to 3,743,097 pounds in December, as compared with 2,400,000 pounds for the same date in 1919. The average quantity of 3,300,300 pounds in bond during 1920 compares with 4,530,000 pounds during 1919. A general comparison for the two years is graphically shown in figure 3 (p. 77).

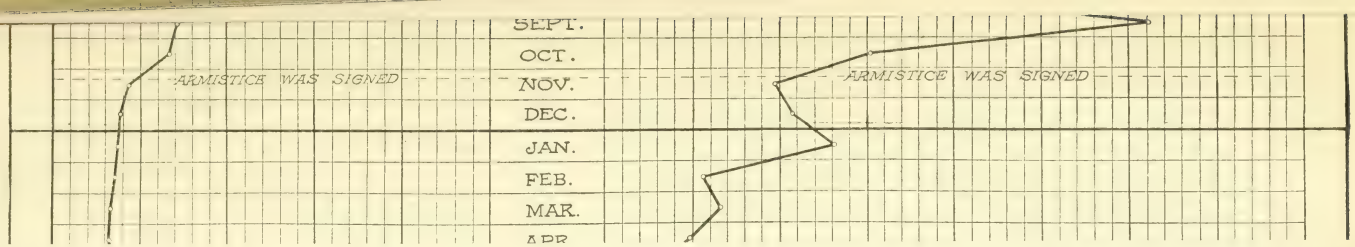
PRICES.

The average yearly New York quotations for the ordinary grades of metallic antimony for the last 26 years, in cents per pound, are given by the Engineering and Mining Journal as follows:

1895–1904	7.53	1917	20.69
1905–1914	10.12	1918	12.58
1915	30.28	1919	8.19
1916	25.37	1920	8.49

The fluctuations in average monthly prices for the ordinary grades of metallic antimony during the seven years 1914 to 1920 are shown diagrammatically in Plate I.

RK MARKET, BY MON



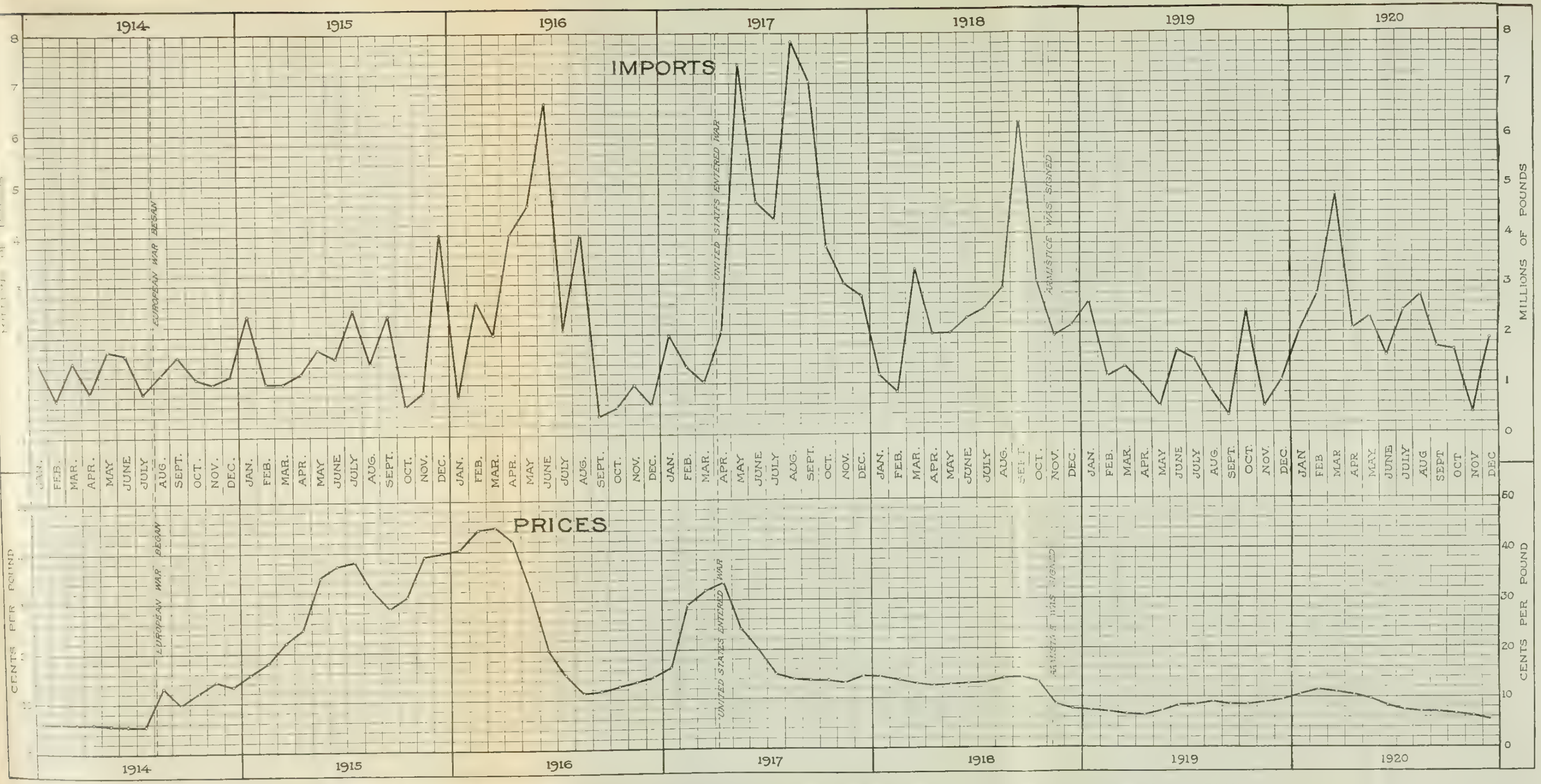


DIAGRAM SHOWING IMPORTS OF ANTIMONY AND AVERAGE PRICES OF ORDINARY GRADES OF ANTIMONY METAL IN NEW YORK MARKET, BY MONTHS, 1914 TO 1920.

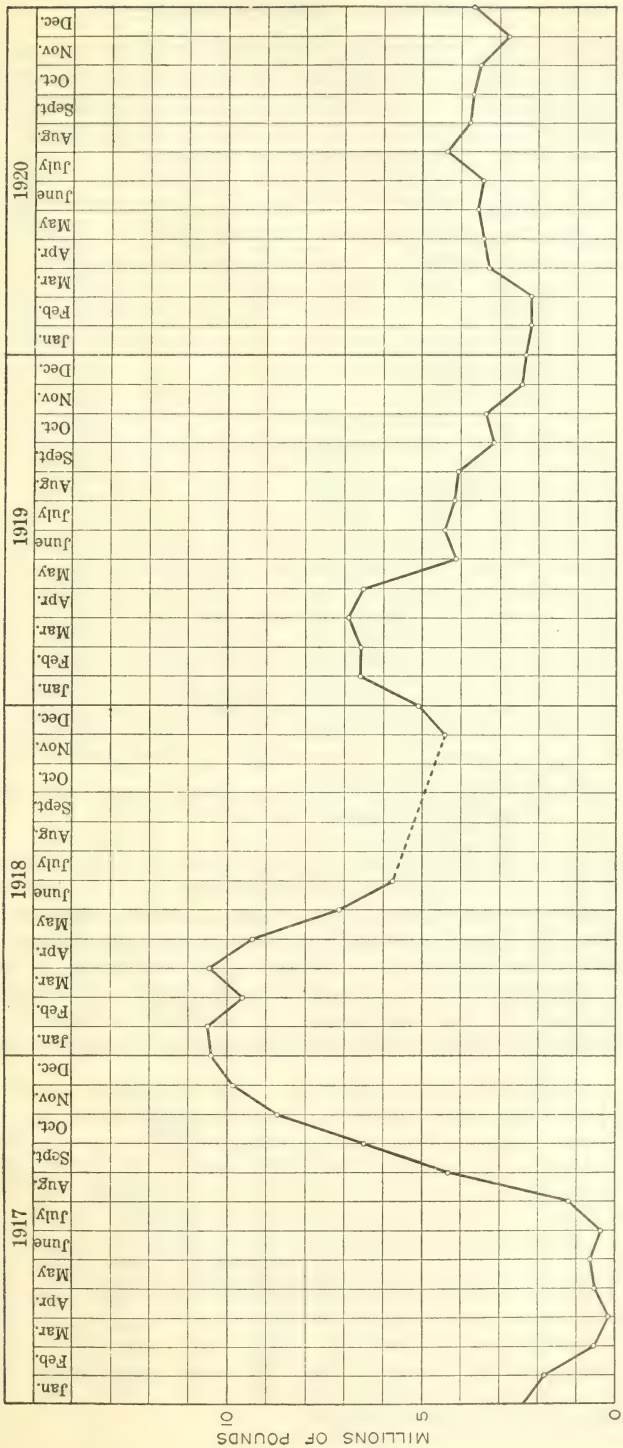


FIGURE 3.—Diagram showing stocks of metallic antimony in bonded warehouse at end of each month, 1917–1920.

WORLD'S PRODUCTION.

The accompanying diagram (fig. 4) gives approximately the world production of antimony in terms of the estimated recoverable content of the ore produced. As the United States is almost completely dependent on foreign sources for its supply of antimony, a brief review of production in foreign countries follows.

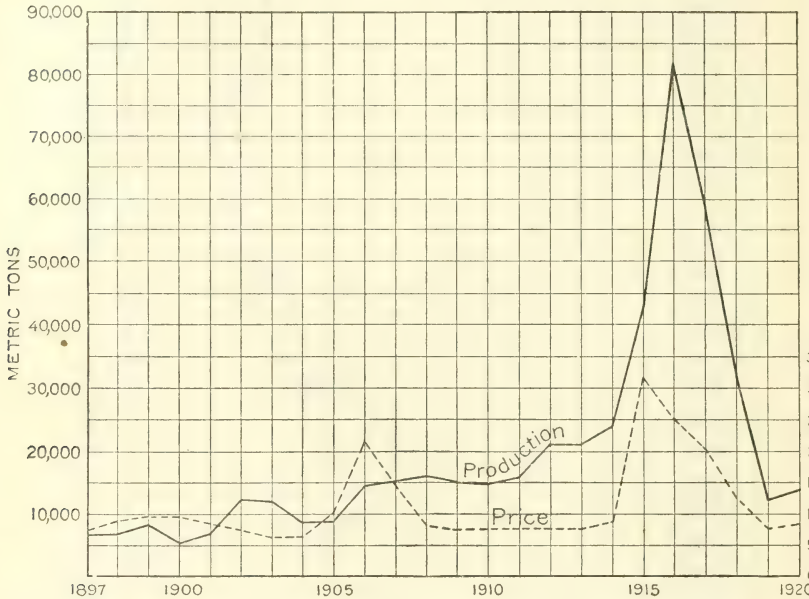


FIGURE 4.—Diagram showing world's production of antimony, based on estimated recoverable content of antimony ore and average price per pound in New York.

The following table shows the world's production of antimony for the years 1913–1920 so far as reasonably approximate data are available. As the data for 1919 and 1920 from many foreign countries are not yet available the total production here given for those years is probably much too small. An attempt has been made to reduce the statistics of production to a common basis—that of the recoverable metal content of the ore produced. It is evident that the world's present capacity to produce antimony far exceeds the normal demand.

World's production of antimony, 1913–1920, in metric tons.

[Approximate recoverable metal content of ore produced, antimonial lead ores not included.]

Country.	1913	1914	1915	1916	1917	1918	1919	19
United States	.....	.....	1,760	1,420	310	45	.....	.....
Canada	.....	.....	381	272	87	7	14	.....
Mexico	2,340	1,570	a200	829	2,647	3,269	628	1,
Bolivia	30	102	9,859	15,077	12,860	4,770	(b)	(b
Peru	.....	.....	260	930	450	160	33	(b
Argentina	.....	.....	.....	.....	812	(b)	(b)	(b
United Kingdom	.....	.....	4	4	2	4	(b)	
Hungary	1,038	(b)	(b)	(b)	444	(b)	(b)	(b
Austria-Hungary	840	(b)	(b)	(b)	(b)	(b)	(b)	(b
Germany	.....	(b)	a700	(b)	(b)	(b)	(b)	(b
France	5,170	540	893	2,430	2,354	1,634	990	a1,
Italy	360	138	720	4,334	960	404	b8	

a Incomplete data; actual production probably larger.
b No data.

World's production of antimony, 1913–1920, in metric tons—Continued.

Country.	1913	1914	1915	1916	1917	1918	1919	1920
Spain	.....	.....	100	170	160	a20	.....	(b)
Portugal	10	(b)	(b)	a1,000	(b)	(b)	(b)	(b)
Serbia	a250	(b)	(b)	(b)	725	(b)	(b)	(b)
Algeria	186	320	2,740	8,940	4,550	2,218	605	(b)
British South Africa	30	.....	50	380	300	99	20	72
China	13,032	19,647	23,357	42,800	31,000	a18,112	8,923	11,252
Japan	20	32	180	280	8	41	(b)	(b)
India	.....	.....	5	400	182	(b)	2	(b)
Indo-China	.....	.....	160	642	101	(b)	(b)	(b)
Borneo	.....	300	120	(b)	(b)	(b)	(b)	(b)
Asia Minor	240	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Victoria	960	890	1,300	1,320	1,004	576	580	.....
New South Wales	10	20	320	310	150	a120	a30	.....
Queensland	.....	.....	80	80	(b)	(b)	3	(b)
Western Australia	.....	.....	.....	20	10	(b)	16	(b)
	24,516	c27,000	c46,000	c84,000	c62,000	c34,000	.....	.....

a Incomplete data; actual production probably larger.
b No data.
c Totals for years 1914–1918 include estimates of production of countries for which data are lacking.

CONSUMPTION.

The world's average annual peace-time consumption of antimony from ore produced, not including antimonial lead ores, is about 22,000 metric tons; and that of the United States 7,000 tons. The United States also uses annually about 2,100 tons of virgin antimony contained in domestic antimonial lead and 3,500 tons of secondary antimony recovered from old alloys, scrap, and dross, a total of 12,600 tons. In computing these averages the abnormally high figures for the years 1915–1917 were omitted.

FOREIGN DEPOSITS.

NORTH AMERICA.

CANADA.[1]

The production of antimony ore in Canada has been extremely irregular. As in the United States, high prices continued over a long period will bring out a considerable production, but no output is to be expected at peace-time prices.

Antimony produced in Canada, with imports and exports, 1920, in short tons.

Ore produced:	
Total	2,643
Metal content	1,037
Smelter production of metal	84
Exports of ore	1,990
Imports:	
Metal	2,037
Salts	90

[1] Wilson, A. W. G., Mining of antimony ores in Canada: Canadian Min. Jour., Feb. 15, 1917. Canada Dept. Mines, Mineral production, 1913–1919. Imp. Inst. Bull., vol. 14, pp. 401–403, 1916.

MEXICO.[2]

Deposits of antimony exist in many parts of Mexico, and a considerable quantity has been produced for many years. The following figures of exports to England and the United States and the reported production from 1912 to 1920 give some idea of the extent of the industry:

Antimony exported from Mexico, 1912–1920, in short tons.

	To England: Crude and regulus.	To United States.	
		Ore.	Metal.
1912	3,296	.....	.....
1913	2,345	.....	.....
1914	1,543	.....	6
1915	(a)	520	.....
1916	(a)	1,339	.....
1917	(b)	1,775	790
1918	.....	1,449	2,660
1919	(a)	297	279
1920	(a)	(a)	(a)

[a] No data.
[b] Probably none.

Metallic antimony produced in Mexico, 1912–1920, in metric tons.[3]

1912	3,500	1917	2,647
1913	2,340	1918	3,269
1914	1,570	1919	628
1915	200	1920	1,572
1916	829		

The principal mines are in the Sierra Catorce, in the States of San Luis Potosi and Queretaro. It is probable that production will be maintained in the future, even during periods of low prices.

SOUTH AMERICA.

ARGENTINA.[4]

In 1911 Argentina produced 30 metric tons and in 1917 2,708 metric tons of antimony ore, which contained about 30 per cent of metal.

BOLIVIA.[5]

Under the stimulus of high war prices Bolivia produced large quantities of high-grade antimony ore from 1915 to 1918.

[2] Flores, T., Los criaderos de antimonio de Mexico: Bol. minero, vol. 1, pp. 193–195, 1916. Orchard, J. E., Mexico: political and commercial control, p. 15, 1918. Weed, W. H., Handbook of Mines, 1918, pp. 1650–1651. Imp. Inst. Bull., vol. 14, p. 403, 1916.

[3] Figures for 1916–1920 from Commerce Reports.

[4] Mines and Quarries (London), 1912, p. 415. Estadística minera de la República: Min. agr., Dir. minas, geol. é hidrol: Bol. 13, Serie A (Minas), pp. 32, 37, 1920.

[5] Min. Jour. (London), Jan. 16, 1915, p. 45, Aug. 3, 1918. Mineral Industry for 1916. Singewald, J. T., and Miller, B. L., The mining industry of Bolivia; Eng. and Min. Jour., Dec. 9, 1916, p. 1005. Soc. Chem. Ind. Jour., vol. 38, p. 9 R., 1919. Bolivia, Comercio especial de Bolivia; exportación, importación, bancos, 1915, La Paz, 1916. Information furnished to War Minerals Committee by Western Metals Co. Consular Repts., July 31, 1920; Aug. 26, 1920.

Metallic antimony produced in Bolivia, 1915–1918, in metric tons.

1915	9,859	1917	12,860
1916	15,077	1918	4,770

The chief producing region is in the southern part of the department of Potosi, particularly the Bustillo, Sur-Chicas, Nor-Chicas, and Porco districts. It is not likely, however, that Bolivia can be an important producer when prices are normal.

Antimony ore shipped from Bolivia, 1915–1918, in metric tons.

Country.	1915	1916 [a]	1917 [a]	1918
England	16,184	17,377	13,887	[b] 2,189
France		1,113	993	
Spain	140			
United States	1,599	4,258	3,460	[b] 727
Chile				153

[a] Data from Western Metals Co. London Min. Jour. (Aug. 3, 1918) gives 25,845 metric tons as the production for 1916, and 21,287 metric tons as the production for 1917.
[b] First five months.

In 1918 13 metric tons of "antimony bars" (presumably liquated antimony) was produced.

PERU.[6]

During the antimony boom of 1906–7 a small quantity of antimony ore was produced in Peru. No further production was made until 1915. From 1915 to 1919 3,683 metric tons of antimony ore was produced, which contained nearly 60 per cent of metal. Although extensive deposits are known in many parts of Peru, more than 90 per cent of the production has come from the Department of Puno, in southern Peru.

EUROPE.

Little information is available regarding the production of antimony in Europe in 1920. France is said [7] to have produced 3,880 tons of antimony ore, and Italy 125 tons. Notes on the European deposits are given in Mineral Resources for 1919, and fuller statistics will appear in the volume for 1921.

ASIA.

BORNEO.[8]

British Borneo was formerly a producer of considerable antimony and exported much ore between 1859 and 1894. In 1914 870 tons of ore was exported, and in 1915 about 350 tons.

[6] Weckwarth, E., Antimonio en Perú: Cuerpo Ing. Minas Bol. 68, 1909. Estadística minera del Perú, 1915–1918. Information supplied by Western Metals Co. Soc. ing. Perú Inf. y mem., vol. 22, No. 8, 1920.
[7] Mining Jour. (London), vol. 133, p. 299, Apr. 23, 1921.
[8] Posewitz, T., Borneo, its geology and mineral resources, London, 1892. Imp. Inst. Bull., vol. 14, p. 297, 1916.

CHINA.[9]

For several years more than 60 per cent of the world's production of antimony has come from China. During the war China produced at more than double the rate of the world's peace-time consumption. The former annual production was more than doubled from 1914 to 1918, inclusive. In 1916 the exports reached their peak and amounted to the equivalent of 42,800 metric tons of metallic antimony. However, from 1917 to 1920, inclusive, owing to adverse exchange conditions due to the high price of silver, which have nearly doubled the cost of production, and to advance in wages, there was a rapid decline in the exports, so that in 1919 they amounted to only about 9,000 tons.

Throughout the year 1919 the stock of the metal was 50 per cent below normal and the price was 64 per cent lower at the end than at the beginning of the year.

No figures for production are available, but exports in recent years have been as follows:

Antimony exported from China, 1913–1920, in short tons.

	1913 [a]	1914 [a]	1915 [b]	1916 [b]	1917 [c]	1918 [d]	1919 [d]	1920 [e]
Regulus	14,361	21,649	23,931	24,740	36,254	19,965	9,724	7,602
Crude					21,805	1,060	1,484	5,649
Ore	4,795	5,479	1,843	12,968	8,667	530	638	573
Refuse								190

[a] Imp. Inst. Bull., vol. 14, p. 392, 1916.
[b] Commerce Repts. (Suppl. 52h), Dec. 19, 1917.
[c] Steel and Metal Digest, p. 514, August, 1918. Commerce Repts., No. 57 (FE–103), Mar. 9, 1920.
[d] Min. Jour., vol. 130, No. 4437. Commerce Repts. (Suppl. 55e), Dec. 7, 1920.
[e] First 9 months: Far Eastern division foreign and domestic commerce, U. S. Dept. Commerce; Min. Jour. (London), Vol. 134, No. 4482, p. 524, gives 15,387 tons antimony.

Antimony is found principally in Hunan, Yunnan, Kweichow, and Kwangsi Provinces. Probably 90 per cent of the total production of China comes from the region about Changsha, the center of the smelting industry in Hunan Province.

The most productive district in Hunan is Kai-keng-shan (Shikung-shan). In 1915 about 70 companies mined antimony along the outcrop of the deposits in this district. The ore, which is mainly stibnite of remarkable purity, occurs as pockets and bunches in a flat bed of dolomitic limestone.

The Wah Chang Mining & Smelting Co. largely controls the production in the Province of Hunan. It operates smelters at Changsha, has a selling agency in New York, and has established a large business in the United States, where Chinese antimony has become firmly established in our markets.

The Bureau of Foreign and Domestic Commerce has issued a circular for investors (No. 30), telling how to acquire financial interest in antimony properties in China.

[9] Imp. Inst. Bull., vol. 14, pp. 397–399, 1916. Moore-Bennet, A. J., The mineral area of western China: Far Eastern Rev., vol. 12, pp. 223–224, 1915. Wheler, A. S., Metalliferous mines of Hunan Province: Far Eastern Rev., vol. 12, p. 135, 1915; Antimony production in Hunan Province, South China: Inst. Mining and Metallurgy Bull. 137, 1916. New atlas and commercial gazetteer of China (compiled by the Far Eastern Geographical Establishment), North China Daily News and Herald (Ltd.), Shanghai. Min. Jour. (London), vol. 130, No. 4437, Sept. 4, 1920.

INDIA.[10]

During the war small quantities of antimony were produced in Burma and Mysore. The total Indian production of antimony ore in 1915–1919 was 1,609 tons. The ore reserves are said to be considerable but difficult of access.

INDO-CHINA.[11]

There are productive antimony deposits of possible future importance in French Indo-China. The metallic production in 1915 to 1917, inclusive, was 903 metric tons.

The antimony ore exported from Indo-China to France, 1914–1917, amounted to 2,329 metric tons.

JAPAN.[12]

Very little antimony ore has been produced in Japan since the development of the Chinese deposits. The smelting of Chinese ores has become an important industry, and the smelter production rose to 10,800 tons in 1916. The Japanese imports from 1917 to 1919 were 25,518 metric tons, and the exports 18,248 tons. It is probable that as long as cheap ore is available in China little production from Japanese deposits can be expected.

TURKEY.[13]

The production of antimony has been much retarded in the Turkish Empire. It comes from the vilayets of Brusa and Smyrna, in eastern Asia Minor. The deposits are large and appear to be rich and capable of greater development. In 1911 the Djinli Kaya mine, near Eudemish, produced 1,500 tons of 50 per cent ore. The production of Asia Minor in 1912 is reported as 677 tons of ore. Exports of antimony ore from Turkey to Great Britain in 1910–1919 were 2,768 metric tons. Some ore was also shipped to Austria, and in 1913 205 tons to France.

AFRICA.

ALGERIA.[14]

The Algerian deposits are probably capable of considerable development. The ores are nearly all oxidized. During the war large deposits were developed at Ain Kerma and supplied antimony to France in 1918.

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[10] Imp. Inst. Bull., vol. 14, p. 398, 1916. India Geol. Survey Rec., vol. 49, pt. 1, p. 13, 1918; pt. 2, p. 74, 1918; vol. 50, pt. 3, p. 143, 1919.

[11] Far Eastern Rev., vol. 13, p. 159, 1916. Eng. and Min. Jour., vol. 107, p. 371, 1919. Commerce Repts., June 25, 1917, p. 1140. Statistique de l'industrie minière, 1914–1918, Paris, 1919; idem, 1916–17, Paris, 1920.

[12] Bliss, E. F., and Grout, F. F., MS. report to War Trade Board, 1918. French Ministry of Blockade, report on antimony, Jan. 31, 1917. Imp. Inst. Bull., vol. 14, p. 399, 1916. Commerce Repts., Feb. 19, 1919. p. 796. Statistique de l'industrie minérale, 1914–1918, Paris, 1919. Glückauf, 28 Aug. 1920, pp. 691, 697. Résumé statistique de l'empire du Japon, 33e année, Tokio, 1919.

[13] Simmersbach, B., Die nutzbaren mineralischen Bodenschätze in der klein asiatischen Turkei: Zeitschr. für Berg, Hutten u. Salinenwesen, vol. 52, p. 533, 1904. Doelter, C., Die Mineralschätze der Turkei: Montan Rundschau, vol. 8, p. 219, 1916. Dominian, L., Mineral resources of the Turkish Empire: Min. and Sci. Press, vol. 98, p. 824, 1909. Weiss, K. G., Mitteilungen uber Lagerstätten in westlichen Anatolien: Zeitschr. prakt. Geologie, vol. 11, p. 255, 1901. Schmeisser, C., Bodenschätze und Bergbau Kleinasiens: Zeitschr. prakt. Geologie, vol. 14, p. 192, 1906. Thomae, W. F. A., Emery, chrome ore, and other minerals in the vilayet of Aidin, Asia Minor: Am. Inst. Min. Eng. Trans., vol. 28, p. 221, 1898. Harris, E. L., consular report quoted in Eng. and Min. Jour., vol. 84, p. 689, 1907. French Ministry of Blockade, report on antimony, Jan. 31, 1917.

[14] Dussert, Etude sur les gisements métallifères de l'Algérie: Annales des mines, 10th ser., vol. 7, 1910, French official statistics. French Ministry of Blockade, report on antimony, 1917. Echo des mines et de la metallurgie, vol. 46, p. 297, June 16, 1918. Metall und Erz, Jahrg. 17, Heft 7, p. 182; Apr. 8, 1920. [1917–1919 said to be figures of the Algerian Export Bureau.]

Antimony ore produced in Algeria, 1912–1919, in metric tons.

Year.	Ore.	Metal content.
1912	4,661	1,771
1913	582	233
1914[a]	1,100	400
1915[a]	9,022	3,428
1916[a]	28,473	11,176
1917	16,248	5,686
1918	7,920	2,772
1919	2,160	756

[a] Exports, metal content approximate only.

BRITISH SOUTH AFRICA.

The most promising antimony deposits in British South Africa appear to be those of the Murchison Range,[15] in northern Transvaal. The principal mine of the range is the United Jack. In 1913–1919 there was shipped from Transvaal 1,610 metric tons of concentrates and crude antimony. In 1920 72 tons of regulus is reported to have been produced. Deposits occur also in the Steynsdorp district, in the Forbes Reef district, in Swaziland, and over a considerable portion of southern Rhodesia.[16]

AUSTRALIA.[17]

The only important antimony-producing district in Australia is the Costerfield district of Victoria. The antimony concentrates average about 48 per cent of antimony and also contain about 2½ ounces of gold to the ton. The output in 1913–1919 was 16,406 long tons.

The Hillgrove district in New South Wales was formerly a considerable producer, the highest annual output being 2,450 tons of ore in 1906. The antimony metal and ore produced in New South Wales in 1912–1919 amounted to 2,110 long tons.

Imports of antimony ore into Great Britain from Australia in 1915 amounted to 3,854 long tons, valued at $471,700.

[15] Hall, A. L., Geology of the Murchison Range: South Africa Geol. Survey Mem. 6, 1912. Union of South Africa, Reports Govt. Mining Engineer, 1914–1917.

[16] South African Min. Jour., vol. 25, p. 465, Aug. 19, 1916; vol. 25, pt. 2, p. 479, Aug. 26, 1916. Molengraaf, G. A. P., Géologie de la République sud-africaine: Soc. géol. France Bull., 4th ser., vol. 1, p. 28, 1901. Reports of the Secretary of Mines of Rhodesia, 1916–17.

[17] Official statistics, Victoria and New South Wales. Imp. Inst. Bull., vol. 14, pp. 405–408, 1916. Carne, J. E., The antimony mining industry in New South Wales; New South Wales Dept. Mines, Min. Res. 16, 1912. Victoria Sec. Mines Ann. Rept., 1918, p. 5. Chem. Eng. and Min. Rev., vol. 12, No. 141, p. 325, 1920. The mineral industry of the British Empire and foreign countries: Antimony (1913–1919).

LEAD.

By C. E. Siebenthal and A. Stoll.

SUMMARY.

The following tabular statement gives the general items regarding domestic production and consumption of refined lead from figures compiled by the United States Geological Survey:

Summary of statistics of refined lead, 1919–20, in short tons.

	1919	1920
PRODUCTION.		
Domestic desilverized lead	208,751	220,327
Domestic soft lead	147,744	189,854
Domestic desilverized soft lead	67,938	66,668
	424,433	476,849
Foreign desilverized lead	57,787	52,808
Total refined primary [a] lead	482,220	529,657
Antimonial lead	13,874	12,535
Secondary [a] lead	122,100	124,650
CONSUMPTION.[b]		
Apparent consumption of primary lead, stocks disregarded	434,143	538,020

[a] "Primary lead," which is produced directly from ore, is here distinguished from "secondary lead," which is obtained by refining skimmings, drosses, and old metals. The statistics of secondary lead are given on p. 89. Wherever in this report the word "lead" is used without qualification it means primary lead.

[b] For method of calculating consumption see p. 93.

The output of refined lead in the United States from domestic ores in 1920 was 476,849 short tons, valued at $76,296,000, at the average selling price of pig lead in New York, a gain, as compared with 1919, of 12 per cent in quantity and of 70 per cent in value.

PRODUCTION.

QUANTITY AND VALUE.

The refined lead produced in the United States from 1720 to 1914 from domestic ores and from foreign ores and base bullion and its value at the average price in New York are shown in a table in the chapter on lead in Mineral Resources for 1914. Details for later years are shown in the table on page 86.

Production, price per pound, and value of refined lead in the United States, 1720–1920.

Year.	Desilverized lead.[a,b]	Soft lead.[c]	Total production.[b]	From domesticores and base bullion.[b]	From foreign ores.	From foreign base bullion.	Price per pound at New York.[d]	Value.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
1720–1913	7,834,081	3,061,047	10,895,128	8,957,261	1,937,867		.....	$965,296,000
1914	383,903	158,219	542,122	512,794	7,639	21,689	$0.039	42,286,000
1915	388,594	161,461	550,055	507,026	9,581	33,448	.047	51,705,000
1916	403,619	167,515	571,134	552,228	6,085	12,821	.069	78,817,000
1917	422,266	188,503	610,769	548,450	15,872	46,447	.086	105,052,000
1918	429,732	210,463	640,195	539,905	15,334	84,956	.071	90,908,000
1919	334,476	147,744	482,220	424,433	7,656	50,131	.053	51,115,000
1920	339,803	189,854	529,657	476,849	8,414	44,394	.08	84,745,000
	10,536,474	4,284,806	14,821,280	12,518,946	2,302,334		.....	1,469,924,000

[a] Desilverized soft lead is included; for quantity see page 87.
[b] Antimonial lead is excluded; for quantity see page 88.
[c] Desilverized soft lead is excluded.
[d] For 1917–1920, average sales price.

PRODUCTION BY STATES.

In addition to the domestic lead ores smelted in this country, small quantities of domestic lead ore have been exported to smelters in Canada. In 1912 soft lead amounting to 63 tons was smelted from Wisconsin ores at Canadian smelters, and in 1913 soft lead amounting to 37 tons from Wisconsin ores and desilverized lead amounting to 98 tons from Idaho and Washington ores were smelted at Canadian smelters. The desilverized lead smelted in Canada from Washington ores amounted to 31 tons in 1914, to 137 tons in 1915, and to 2,001 tons in 1916. In 1917 silver-lead ores from Idaho and Montana smelted in Canada produced 4,570 tons of lead. Ores from Washington yielded 1,388 tons of lead at Canadian smelters in 1918 and 3 tons in 1919, but no lead ore from the United States was treated in Canada in 1920.

Primary lead smelted or refined in the United States, 1914–1920, by sources, in short tons.

Source of ore.	1914	1915	1916	1917	1918	1919	1920
Domestic ore:							
Alaska	.....	358	659	884	531	645	591
Arizona	5,601	6,953	15,328	7,456	6,195	5,407	5,987
Arkansas [a]	52	51	170	300	14	.....	.....
California	3,698	5,606	3,633	11,471	6,228	2,004	2,260
Colorado	41,198	32,352	33,046	29,327	29,395	18,867	17,752
Idaho	177,827	160,680	170,059	174,045	142,640	89,091	117,191
Illinois [a]	427	910	670	867	1,010	977	948
Iowa [a]	34	.....	.....	.....	.....	.....	.....
Kansas [a]	1,043	1,320	1,737	2,663	5,023	7,951	8,421
Kentucky [a]	16	95	37	21	109	83	114
Missouri [a]	194,275	195,634	218,253	218,197	187,743	150,341	171,999
Montana	4,386	4,853	4,961	5,933	17,586	17,513	13,231
Nevada	5,996	7,664	11,858	12,334	8,726	5,958	8,650
New Hampshire	.....	3	46	.....	.....	16	.....
New Mexico	741	2,157	3,290	3,428	5,140	1,418	1,123
New York	.....	.....	.....	.....	49	.....	.....
Oklahoma [a]	3,916	4,346	10,969	19,646	58,755	49,984	68,494
Oregon	17	11	9	.....	6	.....	.....
South Dakota	2	5	12	34	28	18	6
Tennessee [a]	.....	8	.....	.....	843	2,371	2,705
Texas	89	111	26	58	30	8	1
Utah	88,976	106,105	111,789	82,081	76,169	65,102	64,006
Virginia [a]	143	457	740	147	59	.....	.....
Washington	2	11	217	929	906	1,090	2,460
Wisconsin [a]	1,819	2,632	3,121	2,930	4,275	3,975	3,841
Undistributed	99	128	113	145	59	119	201
Zinc residues	4,125	4,562	5,478	6,489	5,359	4,887	4,366
	534,482	537,012	596,221	579,385	556,878	427,825	494,347
Foreign ore:							
Africa	2,942	.....	328	1,738	1,519	644	1,171
Australia	.....	.....	.....	.....	282	69	450
Canada	2	1,174	1,231	1,100	7,550	1,895	1,186
Central America	.....	1	7	.....	.....	12	22
Mexico	2,386	5,437	1,917	7,607	4,798	2,261	2,729
South America	1,821	2,829	2,366	1,533	1,101	2,537	2,747
Other foreign	488	140	236	3,894	84	238	109
Foreign base bullion:							
Canada	.....	.....	1,072	6,750	8,108	567	1,919
Mexico	21,689	33,173	11,598	39,508	76,809	49,564	42,421
South America	.....	275	151	189	39	.....	54
	29,328	43,029	18,906	62,319	100,290	57,787	52,808
Grand total	563,810	580,041	615,127	641,704	657,168	485,612	547,155

[a] The lead produced by these States is nonargentiferous or soft lead.

SOFT LEAD.

The lead ores of the Mississippi Valley are almost free from silver, and the lead produced from them is known as "soft lead."

Soft lead produced in the United States, 1914–1920, in short tons.

Year.	Soft pig lead.			Soft lead recovered in pig ments.	Total soft lead.	Total domestic lead.[a]	Soft lead percentage of total domestic lead.
	Undesilverized.	Desilverized.	Total soft pig lead.				
1914	158,219	43,506	201,725	11,914	213,639	537,676	40
1915	161,461	44,001	205,462	12,782	218,244	536,312	41
1916	167,515	68,244	235,759	13,252	249,011	580,225	43
1917	188,503	56,268	244,771	12,870	257,641	574,338	45
1918	210,463	47,418	257,881	13,093	270,974	562,218	48
1919	147,744	67,938	215,682	11,479	227,161	444,250	51
1920	189,854	66,668	256,522	15,960	272,482	500,841	54

[a] Includes domestic refined lead, domestic lead in antimonial lead, and domestic lead in pigments.

ANTIMONIAL LEAD.

The production of by-product antimonial lead from argentiferous lead ores derived from all sources, as reported by all lead refineries operating in this country, is shown for the period 1871–1914 (the quantity for years prior to 1891 being estimated from the output of desilverized lead) in a table in the chapter on lead in Mineral Resources, 1914. The figures for later years are given below.

By-product antimonial lead produced in the United States, 1914–1920.

Year.	Total lead refined from base bullion (short tons).	Percentage of by-product antimonial lead.	Antimonial lead.						
			From domestic ore (short tons).	From foreign ore (short tons).	Total.				
					Quantity (short tons).	Value.	Antimony content.		Lead content, by difference (short tons).
							Short tons.	Percentage.	
1914	340,397	4.9	15,475	1,192	16,667	$1,572,167	2,693	16.2	13,974
1915	344,593	6.7	19,371	3,853	23,224	3,665,736	3,425	14.8	19,799
1916	335,375	7.2	17,246	6,792	24,038	4,483,582	3,496	14.5	20,542
1917	365,998	5.1	15,279	3,367	18,646	3,781,560	2,759	14.8	15,887
1918	382,314	4.9	10,777	7,793	18,570	2,826,350	2,566	13.8	16,004
1919	266,538	5.2	9,674	4,200	13,874	1,513,968	1,943	14.0	11,931
1920	273,135	4.6	9,604	2,931	12,535	1,963,255	2,033	16.2	10,502
Average		5.52						14.8	

Details of the production and consumption of antimony in the United States are given in the chapter on antimony in Mineral Resources, 1920.

LEAD PIGMENTS.

Leaded zinc oxide, zinc-lead oxide, sublimed white lead, and sublimed blue lead are made directly from ore. Each of these pigments is discussed and the output given elsewhere in this volume in the chapter on lead and zinc pigments and salts. The lead content of pigments smelted directly from ore is given in the fourth column of the table on page 87. The pigments manufactured from pig lead (white lead, red lead, orange mineral, and litharge) are also discussed and the output given in the chapter on lead and zinc pigments.

SECONDARY LEAD.

Secondary lead is obtained mainly from skimmings, drosses, old metal, and alloys, such as babbitt, solder, and type metal. The recovery of lead by refining these materials constitutes an integral part of the lead industry.

Secondary lead recovered in the United States, 1914–1920, in short tons.

Year.	Pig lead.	Lead in alloys.	Total recovered lead.	Value.
1914	29,337	31,725	61,062	$4,763,000
1915	36,400	42,500	78,900	7,416,000
1916	56,700	39,600	96,300	13,289,000
1917	45,100	48,400	93,500	16,082,000
1918	41,146	55,954	97,100	13,788,000
1919	55,684	66,416	122,100	12,943,000
1920	56,350	68,300	124,650	19,944,000

MINE PRODUCTION.

The preceding tables give the quantity of lead recovered by smelting and refining operations either as metallic lead, or in the alloy antimonial lead, or as lead in pigments. The origin of the lead is much more accurately shown by the mines reports, because smelters necessarily treat mixtures of ores, sometimes long after they have been received, so that the actual output of metallic lead may not correspond at all closely to the product of the mines for the same year.

The following table gives the mine output of lead since 1914. Figures of mine production for 1907–1918, inclusive, are given on page 946 of the chapter on lead in Mineral Resources for 1918.

Mine production of lead by States, 1914–1920, in short tons.

State.	1914	1915	1916	1917	1918	1919	1920
Alaska	28	437	820	852	564	687	875
Arizona	7,502	10,869	13,531	11,733	6,252	5,102	7,300
Arkansas	41	63	272	382	120	28	8
California	2,126	2,290	6,204	10,934	6,686	1,784	2,407
Colorado	37,106	34,405	35,457	33,995	32,980	18,535	23,315
Georgia	.....	.....	.....	.....	.....	.....	2
Idaho	174,263	173,000	187,541	196,780	147,348	91,171	124,805
Illinois	717	954	1,072	1,439	2,273	2,105	1,743
Iowa	.....	.....	14	34	.....	.....	.....
Kansas	1,409	1,212	1,648	3,025	7,252	11,283	16,788
Kentucky	16	251	153	123	185	86	122
Maine	.....	.....	.....	.....	.....	1	.....
Massachusetts	.....	.....	.....	.....	.....	.....	14
Missouri	192,612	210,440	233,088	234,156	194,175	163,290	165,114
Montana	4,828	6,878	6,798	10,976	18,568	17,219	15,627
Nevada	6,405	8,319	12,819	13,839	11,658	7,675	10,632
New Hampshire	.....	3	47	48	30	.....	.....
New Mexico	882	2,271	4,107	4,554	4,199	1,443	1,435
New York	.....	.....	.....	.....	29	.....	.....
North Carolina	.....	.....	.....	1	.....	.....	.....
Oklahoma	7,556	7,306	12,115	26,358	56,097	53,872	65,394
Oregon	8	31	14	.....	5	.....	.....
Pennsylvania	.....	6	.....	.....	.....	.....	7
South Dakota	2	2	18	34	27	16	6
Tennessee	.....	1	16	2,531	1,705	2,188	1,979
Texas	75	110	25	1	13	7	.....
Utah	85,662	99,984	100,745	89,261	83,504	61,915	70,419
Virginia	127	339	728	859	815	.....	.....
Washington	33	148	2,700	4,895	2,636	1,073	2,894
Wisconsin	1,494	2,322	3,043	4,139	4,533	4,214	2,647
	522,892	561,641	622,975	650,949	581,654	443,694	513,533

COMPARISON OF TOTALS BASED ON SMELTER RETURNS AND ON MINE RETURNS.

The statistics of lead actually recovered by the smelters as refined pig lead, as antimonial lead, and in pigments, and the statistics of mine production (in large part expressed as lead content of ores produced) are compared over a period of years in the following table:

Domestic lead recovered and lead mined in the United States, 1907–1920, in short tons.

Year.	From smelter reports.	From mine reports.	Smelter excess.	Mine excess.
1907–1913	2,704,368	2,903,479	.....	199,111
1914	537,676	522,892	14,784	.....
1915	536,312	561,641	.....	25,329
1916	580,225	622,975	.....	42,750
1917	574,338	650,949	.....	76,611
1918	562,218	581,654	.....	19,436
1919	444,250	443,694	556	.....
1920	500,841	513,533	.....	12,692
	6,440,228	6,800,817	.....	360,589

TRADE CONDITIONS.

WORLD'S PRODUCTION.

World's production of work lead, 1913–1920.

[By countries where smelted but not necessarily refined, in metric tons.]

Country.	1913	1914	1915	1916	1917	1918	1919	1920
Australia	**110,444**	**101,788**	**102,721**	**134,072**	**144,950**	**163,368**	**83,408**	**7,802**
Africa:								
Rhodesia	**295**	**136**	**25**	.....	**5,028**	**8,311**	**10,172**	13,247
Tunis	(a)	(a)	(a)	(a)	**16,533**	(a)	(a)	(a)
Austria-Hungary [b]	24,000	32,000	34,500	36,500	34,400	33,000	(a)	(a)
Belgium	**103,480**	**70,980**	**16,770**	**15,560**	**22,745**	**20,630**	**53,590**	**16,040**
Canada	**17,202**	**16,531**	**19,740**	**19,879**	**20,709**	**17,005**	**16,143**	**13,733**
France	**28,817**	**29,601**	**14,539**	**24,276**	**21,235**	**12,778**	**10,928**	(a)
Germany:								
Upper Silesia [c]	41,300	36,950	28,750	41,620	32,960	23,960	18,580	[d] 8,579
Other Germany	147,000	143,000	93,000	65,000	53,000	46,000	33,000	(a)
Great Britain	30,990	20,000	16,020	12,980	11,614	11,269	11,458	(a)
Greece	**18,309**	**20,684**	**11,595**	**9,424**	**1,422**	4,093	3,841	4,815
India (Burma)	**5,951**	**10,717**	**13,738**	**14,011**	**17,233**	**19,380**	**19,396**	24,198
Italy	**21,674**	**20,464**	**21,812**	**24,362**	**16,237**	**18,332**	**16,530**	(a)
Japan	**3,777**	**4,562**	**4,764**	**11,371**	**15,807**	**10,684**	**5,771**	(a)
Mexico [e]	62,000	23,598	31,384	19,966	46,612	88,503	78,645	84,200
Russia	**1,523**	**1,080**	**935**	**540**	(a)	(a)	(a)	(a)
South America [e]	2,729	3,145	4,667	4,267	4,571	5,268	7,234	5,510
Spain	**198,829**	**143,524**	**171,474**	**147,407**	**176,309**	**169,709**	**125,721**	(a)
Sweden	**1,235**	**1,396**	**1,917**	**2,076**	**3,174**	**2,241**	**827**	800
Turkey [b]	13,900	1,100	1,100	1,100	3,000	3,300	1,000	1,000
United States (refined lead)	**385,643**	**472,126**	**468,656**	**506,490**	**511,942**	**503,702**	**391,982**	**440,221**
Known output	1,219,000	1,153,000	1,058,000	1,091,000	1,143,000	1,178,000	888,000	620,000

[a] Statistics not available.
[b] Metallgesellschaft (statistical publication), 21st vol., 1921.
[c] Upper Silesian Mining and Smelting Syndicate.
[d] January to June only.
[e] Amer. Bur. Metal Statistics Year Book, 1920.

The foregoing statistics of the world's production of lead, though incomplete, give some idea of the foreign production during the war. The figures in black-faced type are taken from the official statistics of the countries named; those in ordinary type are taken from statistical handbooks, consular reports, market letters, and trade journals. There is always a possibility of duplication in figures showing world production, for some countries send "work lead" or base bullion to other countries for refining. Furthermore, secondary and antimonial lead are included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in its production the domestic output of secondary lead and antimonial lead. The figures for the United States represent refined lead that was smelted in this country, whatever the source of the ore.

IMPORTS AND EXPORTS.

The following tables are taken from the records of the Bureau of Foreign and Domestic Commerce.

WAREHOUSE TRANSACTIONS.

Lead remaining in warehouse in the United States, Dec. 31, 1914–1920, in pounds.

Year.	Form in which lead was entered for warehouse.		Remaining at—				
	Lead in ore and base bullion.	Pigs, bars, and old.	New York.	Chicago, Ill.	El Paso, Tex.	St. Louis, Mo.	San Francisco, Calif.
1914	15,333,064	3,837	10,309,592	94,775	4,802,961	125,736	.....
1915	24,338,933	.....	8,401,728	165,257	14,678,809	104,922	988,217
1916	23,667,358	1,070,298	8,575,115	4,732,535	6,814,844	3,286,189	258,675
1917	47,853,945	5,370,445	19,015,511	4,757,315	18,951,649	2,306,855	2,822,615
1918	33,997,822	944,483	(a)	(a)	(a)	(a)	(a)
1919	96,952,684	468,154	(a)	(a)	(a)	(a)	(a)
1920	102,440,325	2,644,576	(a)	(a)	(a)	(a)	(a)

a Not available.

IMPORTS.

Lead imported and entered for consumption in the United States, 1914–1920.

Year.	Lead in ore.		Base bullion.		Pigs, bars, and old.		Sheets, pipe, and shot.		Not otherwise specified.	Total value.
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.		
1914	5,459,961	$188,749	8,904,649	$301,195	575,290	$12,281	62,552	$2,753	$81,894	$586,872
1915	2,865,792	96,010	15,496,230	519,355	997,368	32,951	201,510	17,059	107,580	772,955
1916	10,125,983	368,824	5,242,171	208,277	6,388,097	331,235	532	63	106,560	1,014,959
1917	5,438,931	207,370	6,965,849	470,539	1,756,223	85,743	12,538	2,699	10,287	776,638
1918	6,064,902	344,080	3,559,071	180,070	1,139,950	56,694	6,892	624	36,723	618,191
1919	4,106,823	196,363	31,796,693	1,130,937	10,174,115	415,094	8,018	628	17,187	1,760,209
1920	13,700,499	908,619	66,816,820	3,340,600	68,901,959	3,887,821	81,396	5,483	21,328	8,163,851

Type metal imported and entered for consumption in the United States, 1914–1920.

Year.	Type metal.		Lead content.	
	Gross weight (pounds).	Value.	Quantity (pounds).	Percentage.
1914	1,509,538	$45,373	1,322,188	87.6
1915	2,768,261	107,607	2,424,306	87.6
1916	1,162,386	83,816	923,473	79.4
1917				
1918	551,794	35,938	513,166	93.0
1919	13,394,803	816,642	11,000,498	82.1
1920	29,887,353	1,349,495	25,761,543	86.2
Average lead content, 1914–1920				85.1

General imports of lead into the United States, in ore, base bullion, and refined, 1914–1920, by sources, in pounds.

Year.	Canada.	Mexico.	South America.	Europe.	Other countries.	Total imports.
1914	384,007	46,282,207	2,417,744	4,898,552	2,694,293	56,676,803
1915	2,303,170	94,247,384	5,420,567	217,773	802,516	102,991,410
1916	12,606,216	48,395,670	6,235,758	575,759	2,845,949	70,659,352
1917	11,738,379	125,782,759	4,556,460	8,945,899	5,520,323	156,543,820
1918	28,225,878	162,259,199	1,962,124	62,510	4,705,049	197,214,760
1919	10,391,115	125,541,614	5,504,416	89,840	286,142	141,813,127
1920	8,199,234	131,815,278	7,085,351	38,766,504	11,163,160	197,029,527

General imports of lead into the United States, 1914–1920, by classes, in pounds.

Year.	Lead in ore (lead content).	Base bullion.		Pigs, bars, sheets, and old.	Total lead content.
		Gross weight.	Lead content.		
1914	23,649,637	33,444,503	32,730,320	296,846	56,676,803
1915	18,185,140	86,247,995	83,986,988	819,282	102,991,410
1916	35,086,100	24,943,660	24,262,435	11,310,817	70,659,352
1917	41,292,876	109,279,997	103,664,970	11,585,974	156,543,820
1918	37,070,340	155,810,003	149,663,889	10,480,531	197,214,760
1919	19,573,856	115,317,160	112,024,518	10,214,753	141,813,127
1920	29,488,816	101,476,550	96,103,603	71,437,108	197,029,527

EXPORTS.

DOMESTIC EXPORTS.

The high price of lead shortly before and during the World War made it profitable to export domestic lead. Beginning in March, 1914, the exports soon reached large quantities, but they declined rapidly after the war.

Refined lead made from domestic ores and exported from the United States, 1914–1920.

Year.	Quantity (short tons).	Value.
1914	58,722	$4,501,674
1915	88,306	7,928,518
1916	100,500	13,494,065
1917	53,688	9,560,598
1918	41,831	5,889,381
1919	10,510	1,471,256
1920	2,730	462,223

FOREIGN EXPORTS.

By foreign lead exports are meant the exports of lead of foreign origin which has been smelted, refined, or manufactured in this country and then shipped abroad.

Foreign lead exported from the United States, 1914–1920.

Year.	Exported from warehouse.							Exported in manufactures with benefit of drawback.	
	Lead content of ore.		Lead content of base bullion.		Pigs, bars, and old.		All other manufactures.	Lead content of ore.	Pigs, bars, bullion, and old.
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Value.	Quantity (pounds).	Quantity (pounds).
1914	6,724,525	$245,205	10,944,350	$378,286	25,421,500	$913,306	$2,242	4,040,924	14,936,428
1915	(a)	.....	(a)	.....	77,236,303	2,738,263	40,112	7,966,372	
1916	(a)	.....	(a)	.....	19,760,086	1,111,653	541	10,341,075	
1917	(a)	.....	(a)	.....	75,304,480	6,650,157	900	15,074,947	
1918	(a)	.....	(a)	.....	118,832,344	8,309,798	4,347	6,852,173	
1919	(a)	.....	(a)	.....	81,951,396	4,536,273	44	3,872,130	
1920	(a)	.....	(a)	.....	34,725,501	2,570,535	35,146	12,350,794	

a Since July 1, 1915, the Bureau of Foreign and Domestic Commerce has classed all foreign lead exported as "domestic exports, of pigs, bars, etc., produced from foreign."

CONSUMPTION.

Apparent consumption of refined primary lead in the United States, refinery stocks disregarded, in short tons, 1914–1920.

	1914	1915	1916	1917	1918	1919	1920
Supply:							
Stock in bonded warehouses, Jan. 1	.....	2	.....	535	2,685	472	234
Imports of pigs, bars, and old	148	410	5,655	5,793	5,240	5,107	35,719
Production	542,122	550,055	571,134	610,769	640,195	482,220	529,657
	542,270	550,467	576,789	617,097	648,120	487,799	565,610
Withdrawn:							
Exports of foreign lead—							
From warehouse	21,545	38,618	9,880	37,652	59,416	40,976	17,363
In manufactures, with benefit of drawback	9,489	3,983	5,171	7,537	3,426	1,936	6,175
Exports of domestic lead	58,722	88,306	100,500	53,688	41,831	10,510	2,730
Stock in bonded warehouses, Dec. 31	2	.....	535	2,685	472	234	1,322
	89,758	130,907	116,086	101,562	105,145	53,656	27,590
Apparent consumption	452,512	419,560	460,703	515,535	542,975	434,143	538,020

PRICES AND VALUE.

At the beginning of 1920 lead for immediate delivery was quoted at 7.75 cents a pound in the open market at New York, but by

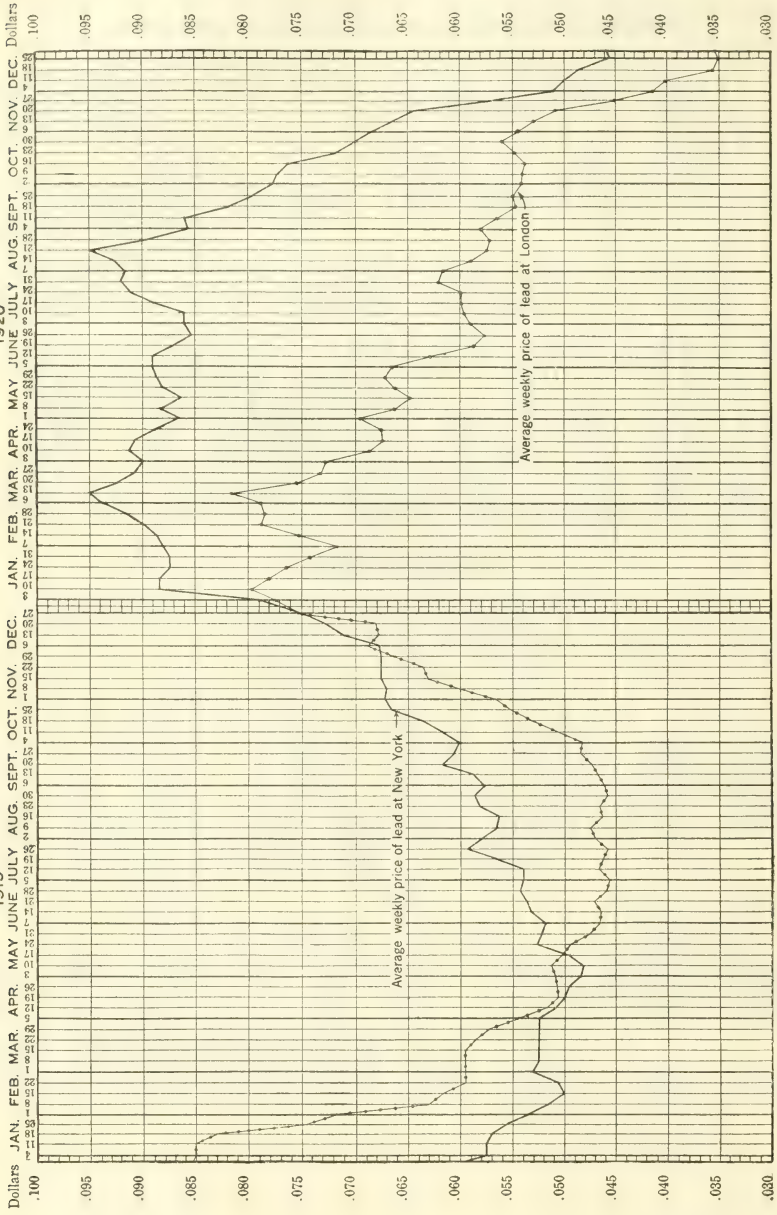

FIGURE 5.—Average weekly price of lead at New York and London, 1919–1920.

January 6 it had risen to 8.875 cents and by March 8 to 9.5 cents. After a decline of nearly a cent a pound it rose again to 9.5 cents on August 16. Later there was a sharp and continuous decline (coin-

cident with large receipts of foreign lead at New York) to 4.5 cents on December 21, though the price rose to 4.7 cents by the end of the year.

The average quoted price of lead for prompt delivery at New York for the year was 8.2 cents a pound, as compared with an average of 5.8 cents in 1919. As a matter of fact, for the first eight months of 1920 the price averaged almost 9 cents a pound. The average price as figured from the total sales during the year was 8 cents a pound, as compared with 5.3 cents a pound in 1919. These are the figures used in calculating the value of the lead produced from domestic ores in the United States in those years.

Prices quoted on lead by the American Smelting & Refining Co. in 1920, in cents a pound.

Jan. 2	7.75	Aug. 12	9.00
Jan. 3	8.00	Sept. 13	8.50
Jan. 12	8.25	Sept. 23	8.00
Jan. 14	8.50	Sept. 29	7.75
Feb. 7	8.75	Oct. 15	7.25
Feb. 24	9.00	Nov. 8	7.00
Mar. 5	9.25	Nov. 15	6.50
May 7	8.50	Nov. 22	6.00
June 15	8.25	Nov. 30	5.50
June 16	8.00	Dec. 3	5.00
July 21	8.50	Dec. 20	4.75

The London price of lead started the year at £45 15s. a long ton (7.75 cents a pound, exchange rate taken into account), reached £47 10s. a ton (which was nevertheless only 7.06 cents a pound on account of a drop in exchange), and increased on March 9 to £50 5s. a ton (8.25 cents a pound). From this point the trend of the London price was generally downward. In August, at the time of the break in New York prices, the spread between the New York and London prices was nearly 4 cents a pound. The London price began to break rapidly in the later part of October and finished the year at £23 10s. a ton (3.7 cents a pound). The average price for the year is given as £38 4s. 7d. a long ton (at the average rate of exchange 6.15 cents a pound), as compared to £28 3s. 11$\frac{1}{6}$d. a long ton in 1919 (5.63 cents a pound at the average rate of exchange).

The fluctuations in the price of lead at New York and London are graphically shown in figure 5, which gives curves of the average weekly price of lead in those markets for the years 1919 and 1920.

As stated on page 85, the value of the output of refined lead in the United States from domestic ores in 1920 was $76,296,000, at the average sales price of refined lead, as compared with $44,990,000, based on the average price in 1919, a gain of 70 per cent.

SECONDARY METALS.

By J. P. Dunlop.

INTRODUCTION.

SCOPE OF REPORT.

"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, and drosses and are so called to distinguish them from metals derived directly from ores, which are termed "primary metals." The distinction does not imply that secondary metals are of inferior quality, for metals derived either from ore or from waste material vary in purity and in adaptability to use in making certain products. The reports to the United States Geological Survey now include secondary copper, zinc, lead, tin, antimony, aluminum, and nickel. The figures obtained by the Survey are supplemental to those on primary metals and are given to enable producers and consumers to form a more comprehensive idea of the quantities of metal available for consumption; in fact, they constitute an essential addition to those given in the seven general reports on primary metals.

RECOVERY OF WASTE MATERIAL.

The collection of waste material is a regular branch of industry. Practically no waste is now handled voluntarily, as there is no longer an urgent need to supply material for military uses.

The flow of material from large plants has not been interrupted by the prevailing low prices of waste material, but the collecting of scrap metal and other waste material by itinerant dealers in country districts has been greatly reduced, because the high cost of transportation and sorting absorbed most of the profit. Metallic scrap eventually reaches the market, but much paper stock is destroyed rather than kept to be sold.

The scarcity of many primary metals in 1918 and 1919 resulted in the more extended use of scrap in making products for which only primary metals had been used. It also brought about the greater use of reclaiming equipment, better handling and segregation of waste metal, and better technical supervision.[1]

There has been an abundant supply of scrap metal in Great Britain, France, and Germany, which has undoubtedly affected the consumption of new metal. War uses ceasing, millions of tons of material was converted to scrap.[2]

Economies in Government printing make it necessary to omit the general review of the waste-material industry in 1920 and considerable other matter that is usually given in this report. The chapters on secondary metals in Mineral Resources for 1918 and 1919 contain much information regarding the collection of waste material.

[1] Diegel, C., Utilization of scrap and residues in metal foundries: Metal Industry, May, 1921, pp. 196–197.
[2] Scrap contribution to the world's metal stock: Min. Jour., Mar. 26, 1921, p. 236.

SOURCES OF INFORMATION.

The Geological Survey receives many letters inquiring as to the treatment of drosses and skimmings, the composition of alloys suitable for certain uses and other technical matters, to which it is not able to make answer, though it invariably endeavors to indicate where such information may be obtained if it is obtainable. Certain trade papers and journals that give the source and nature of waste material and the prevailing prices of all kinds of scrap metals contain also replies to questions relating to remelting, refining, and methods of alloying.

In addition to these trade papers, such as American Metal Market, Daily Metal Reporter, and Daily Metal Trade, issued daily, everyone interested in metals should obtain the more comprehensive and technical information given in weekly or monthly trade journals, such as the Waste Trade Journal, Metal Industry, Raw Material, Brass World, Foundry, Iron Age, and Iron Trade Review.

Copies of the separate chapter on secondary metals from Mineral Resources, 1919, which contains an article entitled "The secondary metal industry," by William Crawford Hirsch, and excerpts on the character and proper use of many scrap metals, are still available (September, 1921) and may be obtained from the Director, United States Geological Survey, Washington, D. C. A very useful and comprehensive book by George H. Manlove and Charles Vickers, entitled "Scrap metals," has been published by the Penton Publishing Co., Cleveland, Ohio.

CLASSIFICATION OF OLD METALS.

The classification of old metals drawn up by the metal division of the National Association of Waste Material Dealers (Times Building, New York City) and changed from time to time as was found desirable has become the standard with both dealers and manufacturers all over the United States. Its latest classification (circular G) is effective until July 1, 1922, when a new circular will be issued. The metal division, as well as all other divisions of the association, has a grievance committee, whose duty it is to adjust differences between members or to arrange for arbitration if it becomes necessary. This division has in recent years been able to remedy trade abuses, and its constructive work has attracted to it practically all dealers in metal wastes. The present classification follows:

Standard classification for old metals, effective from July 1, 1921, to July 1, 1922.

1. Delivery:

(*a*) Delivery of more or less on the specified quantity up to 2½ per cent is permissible.

(*b*) If the term "about" is used, it is understood that 5 per cent more or less of the quantity may be delivered.

(*c*) Should the seller fail to make deliveries as specified in the contract, the purchaser has the option of canceling all of the uncompleted deliveries or holding the seller for whatever damages the purchaser may sustain through failure to deliver, and if unable to agree on the amount of damages, the arbitration committee of the National Association of Waste Material Dealers (Inc.), appointed for this purpose, to determine the amount of such damages.

(*d*) In the event that buyer should claim the goods delivered on a contract are not up to the proper standard, and the seller claims that they are a proper delivery, the dispute shall be referred to the arbitration committee of the National Association of Waste Material Dealers (Inc.), to be appointed for that purpose.

1. Delivery—Continued.

(*e*) A contract for a carload, unless otherwise agreed upon, shall mean the minimum quantity recognized by the official classification tariff of the district in which the seller is located.

(*f*) A ton shall be understood to be 2,000 pounds, unless otherwise specified.

(*g*) If, through embargo, a delivery can not be made at the time specified, the contract shall remain valid and shall be completed immediately on the lifting of the embargo, and terms of said contract shall not be changed.

(*h*) In case of a difference in weight and the seller is not willing to accept buyer's weights, a sworn weigher shall be employed and the party most in error must pay the costs of handling and weighing.

2. Heavy copper:

This shall consist of copper not less than one-sixteenth inch thick and may include trolley wire, heavy field wire, heavy armature wire, that is not tangled, and also new copper clippings and punchings, untinned and clean, and copper segments that are clean.

3. No. 1 copper wire:

To consist of clean untinned copper wire not smaller than No. 16 B. & S. wire gage, to be free from burnt copper wire which is brittle and all foreign substances.

4. No. 2 copper wire:

To consist of miscellaneous clean copper wire such as of necessity would be taken out of the heavy copper and the No. 1 copper wire, but to be free of hair and burnt wire which is brittle.

5. Light copper:

Shall consist of the bottoms of kettles and boilers, bathtub linings, hair wire, burnt copper wire which is brittle, roofing copper and similar copper, free from radiators, brass, lead, and solder connections, readily removable iron, old electrotype shells, and free of excessive paint, tar, and scale.

6. Composition or red brass:

Shall consist of red scrap brass, valves, machinery bearings, and other parts of machinery, including miscellaneous castings made of copper, tin, zinc, and/or lead, no piece to measure more than 12 inches over any one part, to be free of aluminum and manganese, also free of railroad boxes, cocks and faucets, gates, pot pieces, ingots, and burned brass.

7. Railroad bearing:

Shall consist of railroad boxes or car-journal bearings, must be old standard used scrap, free of yellow boxes, plastic and similar bearings, also iron-backed boxes, and must be free of babbitt; also free of excessive grease and dirt.

8. Cocks and faucets:

To be mixed red and yellow, free of gas cocks and beer faucets; shall be at least half red.

9. Heavy yellow brass:

Shall consist of heavy brass castings, rolled brass, rod brass ends, brass screws, and tinned or nickel-plated brass tubing; to be free of iron and dirt, and must be in pieces not too large for crucibles; no piece to measure more than 12 inches over any one part. Must also be free of aluminum and manganese mixtures. Condenser tubes shall not be considered as heavy brass.

10. Light brass.

Shall consist of light sheet brass, forks and spoons, miscellaneous brass that is too light for heavy, to be free of any visible iron, radiators, gun shells containing paper, ashes, or iron, loaded lamp bases, and clock works.

11. New brass clippings:

Shall consist of the cuttings of new sheet brass, to be absolutely clean and free from any foreign substances.

12. Brass tubing:

Shall consist of brass tubing, free of nickel plating, tinned, soldered, or tubes with cast brass connections. To be sound, clean tubes, free of sediment, and condenser tubes.

13. No. 1 composition turnings:

To be free of aluminum, manganese, plastic, and yellow brass turnings, not to contain over 2 per cent iron, to be free of grindings or foreign material, especially babbitt, and free from adulterations made to resemble metal. Turnings not according to this specification subject to sample.

14. No. 1 yellow brass turnings:

Shall consist of strictly rod turnings, free of aluminum, manganese, composition, and tobin turnings. Not to contain over 3 per cent of iron, oil, or other moisture, to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample.

15. No. 1 pewter:
Shall consist of tableware and soda-fountain boxes, but in any case must test 84 per cent tin. Syphon tops to be treated for separately.
16. Auto radiators:
To be classed separately, must be free from iron.
17. Zinc:
Must consist of clean sheet and cast zinc, also cast batteries, to be free of loose oxide and dross, sal ammoniac cans, and other foreign materials.
18. Tin-foil:
Shall consist of pure foil free of lead compositions and other foreign ingredients and matters.
19. Electrotype shells:
Must be hand picked and free of dross.
20. Battery lead plates:
Shall consist of dry-battery lead plates, to be free from wood, rubber, and paper, moisture not to exceed 1 per cent.
21. New sheet aluminum clippings:
Shall consist of new sheet aluminum and cuttings. Must be free from oil, grease, and any other foreign substances. Must be guaranteed not less than 98 per cent pure aluminum.
22. Aluminum wire:
Shall consist of aluminum wire guaranteed 98 to 99 per cent pure aluminum and must be free from corrosion and any other foreign substance.
23. Painted sheet aluminum:
Shall consist of painted sheet aluminum and must be absolutely free from iron, dirt, or any other foreign substance.
24. Aluminum castings:
Shall consist of aluminum castings, free from iron, babbitt, brass, and any other foreign substance. Must not exceed 2 per cent of oil and grease.
25. Old sheet aluminum:
Shall consist of old and manufactured sheet aluminum. Must be free from painted sheet aluminum, iron, dirt, and any other foreign substance.
26. Aluminum borings:
To avoid dispute, should be sold subject to sample.
27. Aluminum foil:
Shall consist of pure aluminum foil, free from paper and any foreign ingredients.
28. Babbitt metal:
Shall contain bearing metal of all kinds. Shall not contain scrap hard metal, Allen metal (which is copper and lead alloy), die cast, zinc boxes, or type metal.
29. Monel metal scrap:
Must be in sheets, clippings, castings, bars, or rods. Must be free of iron and other foreign materials. To avoid disputes, to be sold subject to sample.
30. Monel metal turnings:
Must be free of iron and undue percentage of oil and moisture. To avoid disputes, to be sold subject to sample.
31. Packages:
Shall be good strong packages, suitable for shipment, and each package to be plainly marked with the gross and tare weights so that when packages reach their destination their weights can be easily checked.
When goods are not packed according to the above specifications and shipper wants his rejections returned, the cost of labor shall be charged to the shipper.

REVIEW OF THE SECONDARY-METAL INDUSTRY IN 1920.

Though one or two metals were in active demand at good prices during most of 1920, the general trend of the prices of all metals was downward, and a decrease in demand resulted from the depression that gradually spread to all lines of industry. Much of the profit derived from the advancing prices and active demand in 1918 and 1919 was wiped out by the heavy decline in price of metals held in stock late in 1920. Strikes at brass rolling mills, excess stocks of virgin and scrap metal offered for sale by the Government, heavy imports of scrap brass, copper, and antimonial lead, shortage of fuel, and exasperating delays in rail shipments were other burdens and sources of

expense, so that all who dealt in or smelted secondary metals were fortunate if they realized any profit in 1920.

Dealers in and refiners and smelters of scrap metals and drosses handled more material containing copper, zinc, lead, and antimony in 1920 than in 1919. The quantity of tin, aluminum, and nickel scrap alloys and drosses was considerably smaller. The tin recovered as metal was about 1,200 tons more than in 1919, mainly on account of the increase in the output of tin plate. The tin recovered in alloys and chemical compounds, however, decreased 1,756 tons. Several smelters which had used retorts in 1918 and 1919 to redistill prime western zinc resumed treatment of zinc drosses. The exports of zinc dross decreased from 5,123 short tons in 1919 to 2,445 tons in 1920. In consequence of these changes in conditions the recovery of redistilled and remelted zinc increased 2,940 tons. The zinc recovered in brass and other alloys was about 4,150 tons more in 1920 than in 1919, though this was due mainly to the increased quantity of clean brass scrap used. There was a small increase in recovered lead as metal and in alloys, probably due to active demand early in the year. There was an increase of more than 18,000 tons in the quantity of scrap copper reused in 1920, and the quantity of scrap brass utilized was about 10,000 tons more than in 1919.

During most of the year much more brass scrap was in sight than was necessary to supply the demand, and there was a natural disinclination to purchase brass scrap until the Government holdings of scrap were marketed. A considerable part of both primary metal and scrap metals sold by the Government was not consumed in 1920. Plants that had made war materials were also heavily supplied with accumulated scrap.

The ordinary channels of supply also yielded considerably more brass and bronze than could be absorbed. Brass goods were not actively sought by consumers during 1920, and the large stocks of scrap brass caused a serious shrinkage in the domestic demand for copper and zinc. The increase in the recoveries of antimony was caused by the remelting of considerable quantities of shrapnel bullets, partly imported from Europe.

Many dealers and small smelters were unable to continue operations at the end of the year, or they operated only on a small scale by confining their purchases of material to fill orders on hand. The large smelters and dealers suffered heavy losses by the depreciation in the value of all metals. The general tendency is toward the elimination of the small secondary smelters because of the ability of the larger plants to make alloys and secondary pig metals of guaranteed analysis. This they can accomplish by purchasing large quantities of material and using it to the best advantage under expert chemists and metallurgists.

PRICES.

The dealers' average buying prices at New York of heavy scrap copper and also of No. 1 composition declined 34 per cent in 1920. Scrap lead declined 50 per cent and scrap zinc 42 per cent during the last four months of the year. The price of primary tin decreased from about 64 cents in January to 33 cents in December. Antimony declined from 11.25 cents in January to 5.20 cents in December, and aluminum from 32 to 22.5 cents. The secondary tin, antimony, and

aluminum followed the downward prices of the primary metals. In 1921 the downward trend of all metal prices has continued and the demand has decreased more rapidly than in 1920.

Average scrap-metal prices, 1920, in cents per pound.[a]

[New York dealers' weekly average buying prices.]

	Heavy copper.	No. 1 composition.	Scrap lead.	Scrap zinc.		Heavy copper.	No. 1 composition.	Scrap lead.	Scrap zinc.
January:					July:				
3	17.15	16.15	6.90	5.15	3	16.15	15.40	7.65	6.15
10	17.90	16.75	7.15	5.90	10	16.40	15.25	7.65	6.15
17	17.90	16.90	7.40	5.90	17	16.65	15.65	7.90	6.15
24	17.15	16.40	7.40	5.90	24	15.90	15.40	8.15	6.15
31	17.40	16.40	7.40	5.90	31	15.65	15.40	8.15	6.15
February:					August:				
7	16.90	15.90	7.40	5.40	7	15.65	15.40	8.15	6.15
14	16.90	15.90	7.40	5.15	14	15.65	15.40	7.90	5.90
21	17.40	15.90	7.40	5.15	21	15.65	15.40	8.40	6.15
28	17.40	16.40	7.40	5.40	28	15.15	15.15	8.15	6.30
March:					September:				
6	17.40	16.90	7.90	5.90	4	15.15	15.15	7.90	6.15
13	17.15	16.40	8.15	5.90	11	15.15	15.15	7.90	6.15
20	16.40	16.15	8.15	5.90	18	15.15	15.15	7.65	6.15
27	16.40	16.15	7.90	5.90	25	14.90	13.90	7.40	6.15
April:					October:				
3	16.75	16.15	7.75	6.00	2	15.15	14.40	6.90	5.65
10	17.15	16.65	7.65	5.65	9	14.90	13.90	6.65	5.40
17	16.90	16.40	7.65	5.40	16	14.40	13.90	6.40	4.90
24	16.90	16.40	7.65	5.15	23	13.65	13.25	5.75	4.25
May:					30	12.25	11.75	5.50	4.25
1	16.40	16.15	7.40	5.40	November:				
8	16.65	16.40	7.40	5.40	6	12.75	12.00	5.40	4.25
15	16.15	16.65	7.15	5.65	13	13.40	12.25	5.15	4.25
22	16.15	16.15	7.55	5.15	20	12.65	11.65	5.25	4.15
29	16.15	16.15	7.55	5.15	27	12.25	11.65	4.75	3.65
June:					December:				
5	16.40	16.15	7.65	5.15	4	11.75	11.00	4.00	3.25
12	16.15	16.15	7.55	5.40	11	11.25	10.65	4.15	3.50
19	16.15	15.90	7.40	5.40	18	11.40	10.65	3.90	3.25
26	15.90	15.90	7.25	5.40	25	11.25	10.65	4.15	3.65

[a] Waste Trade Journal, Jan. 20, 1921.

SECONDARY METALS RECOVERED.

The quantity of the metals contained in numerous alloys made partly or wholly from secondary material can not be definitely ascertained. The figures given as the result of the annual inquiry made by the Geological Survey are only approximate, but they are the sole available data on an important industry.

The increase in the value of the secondary metals, exclusive of gold, silver, platinum, iron, steel, and ferroalloys, recovered in the United States was due mainly to the much higher average price of lead and zinc and to the larger quantity of scrap copper and brass.

The value of the secondary platinum, iridium, and palladium recovered in 1920 amounted to $7,134,610, which was about 70 per cent of the value of the platinum and allied metals imported for consumption in the United States in 1920.

The value of the gold or silver contained in old jewelry, dental waste, silver spoons, tableware, ornaments, and other articles remelted or refined in 1920 was more than $37,682,365. Mints and refineries reported the recovery of 8,694,392 fine ounces of silver and $28,205,478 in gold from waste or discarded material. Jewelry and dental waste are the largest sources of secondary gold, and silverware and photographic wastes of secondary silver. The recoveries of silver from waste film and from photographic solutions amounted to more than 1,000,000 ounces, which was less than in

1919. The low price of secondary silver after June, 1920, and the small recovery made from waste films made the handling unprofitable except where there was little or no expense for collecting and shipping. Most of the silver recovered from photographic waste was obtained in New York and California. It is difficult to estimate the value of ferrous scrap remelted in 1920. Estimates of the quantity vary from 6,500,000 to 7,500,000 long tons. A considerable part of the scrap ferrous metal contained nickel, tungsten, manganese, chromium, vanadium, molybdenum, or other alloys, which made it many times more valuable than the ordinary commercial iron and steel scrap, though the market is limited, and some knowledge regarding consumers is necessary to locate prospective purchasers. There continued to be a considerable supply of scrap metals from abandoned steam and electric railways, but the quantity of old metals marketed by operating railway companies was less than usual. Buying of new material by railways was, as in 1919, restricted to urgent needs, and consequently smaller quantities of old rails, car wheels, and other equipment were discarded. The railways are, on the whole, the largest producers of most kinds of metal scrap, as well as the largest users of new and remelted metal. It is estimated that the railways usually supply more than 40 per cent of the scrap iron and steel.

It is impracticable and unnecessary to segregate the statistics relating to the melting, refining, and use of secondary metals according to States. Nearly all the secondary aluminum was reported from Ohio, Michigan, Connecticut, Illinois, and Missouri. The largest recoveries from tin dross, tin scruff, and clean tin scrap were made in Pennsylvania, New York, New Jersey, and Indiana. Nearly all the secondary nickel was reported from Connecticut and New Jersey. The recoveries of lead, zinc, and copper and of such alloys as babbitt, bronze, brass, and pewter were more generally distributed, though the largest secondary smelters and refineries are in Pennsylvania, Illinois, Michigan, Ohio, and New York. There has been some increase in the last few years in the number and capacity of smelters treating secondary metals in San Francisco, Seattle, and Tacoma.

Secondary metals of certain classes recovered in the United States in 1919 and 1920.

	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Copper, including that in alloys other than brass	112,400	$41,812,800	130,600	$48,060,800
Brass scrap remelted	249,700	75,944,100	259,800	77,454,500
Lead as metal	55,684	12,942,600	56,350	19,944,000
Lead in alloys	66,416		68,300	
Zinc as metal	39,910	6,711,900	42,850	8,181,000
Zinc in alloys other than brass and in chemical compounds.	6,062		7,650	
Tin as metal	5,977	29,868,200	7,200	22,705,700
Tin in alloys	18,056		16,300	
Antimony as metal	48	717,900	200	*938,560
Antimony in alloys	4,351		5,400	
Aluminum as metal	6,017	12,014,600	5,000	9,489,100
Aluminum in alloys	12,674		10,500	
Nickel as metal	163	1,829,400	270	1,733,600
Nickel in nonferrous alloys	2,284		1,930	
	.....	181,841,500	.....	188,507,260

SECONDARY COPPER.

Secondary copper recovered in 1920.

	Short tons.
Copper as metal	97,000
Copper in alloys other than brass	33,600
	130,600
Copper from new scrap	45,500
Copper from old scrap	85,100
	130,600
Brass scrap melted:	
New clean scrap	140,000
Old scrap	119,800
	259,800
Copper content of brass scrap (averaging about 70 per cent copper):	
New scrap	98,000
Old scrap	83,860
	181,860
Total secondary copper:	
From new scrap	143,500
From old scrap	168,960
	312,460
Brass scrap imported	22,682
Scrap copper imported	5,475
Brass scrap exported	1,030
Scrap copper exported	289

Of the total quantity of secondary copper recovered in 1920, 40,994 tons (5,351 tons more than in 1919) was recovered by plants refining primary metals and the remainder by plants treating only secondary materials. The copper produced by smelters of secondary material includes 57,006 tons of pig copper, 33,600 tons of copper in alloys other than brass, and 181,860 tons of copper in remelted brass. These figures indicate an increase for 1920 of 8,900 tons of pig copper, of 4,900 tons in alloys other than brass, and of 7,000 tons in brass.

The value of the copper, both as metal and in alloys, is computed at 18.4 cents a pound, the average price for the year of all marketable grades of new metal.

According to the Bureau of Foreign and Domestic Commerce the exports of scrap copper and brass in 1920 showed an increase, and the imports increased about 180 per cent. Many railways sell or turn in the larger portion of their brass and copper scrap and other metal waste to dealers in part payment for new material, but the reports received show that the railways utilized in their own shops and foundries more than 13,000 tons of brass in addition to 995 tons of copper and 10,994 tons of copper in alloys other than brass. The railway reports, however, frequently include alloys termed "brass" which should more properly be designated "bronze." Some other alloys of copper are known by names that do not even suggest the metals alloyed.

The names recommended by the American Society for Testing Materials to be used in connection with certain brass, bronze, and nickel alloys of copper are given in the report on secondary metals in Mineral Resources for 1919.

In the past large producers of certain virgin metals, particularly copper, zinc, and antimony, have paid too little attention to scrap metals; they have not realized that such metals as secondary copper and brass exert sufficient influence to affect the marketing and prices of new metals. The effect of the vast surplus quantity of scrap metals in 1920 has, however, been significantly shown in the much lower consumption of virgin copper and zinc, while manufacturers of brass rods, sheets, and other products purchased large quantities of turnings and cartridge casings. This surplus scrap was not absorbed even in 1920, and the market for primary metals has been affected to a considerable degree by it during 1921.

The production of copper from secondary sources in 1920 was equal to about 38 per cent of the refinery output of primary copper in the United States from all sources, or about 53 per cent of the primary copper smelted from domestic ore.

Considerable information was given in the report on secondary metals for 1919 relating to briquetting small scrap, the desirable methods of disposing of copper-bearing material, the method of reclaiming metal from slag and sweepings, with estimated cost of equipment required, the recovering of tin and copper from brass and bronze, and the handling of brass scrap.

SECONDARY LEAD.

Secondary lead recovered in 1920.

	Short tons.
Secondary lead recovered by smelters that treat mainly ores	12,787
Secondary lead recovered by plants that treat only scrap and drosses	43,563
	56,350
Secondary lead recovered in remelted alloys:	
Lead content of antimonial lead scrap treated at regular lead smelters	2,687
Lead content of drosses and scrap alloys treated at secondary smelters	65,613
Total lead in alloys	68,300
Total secondary lead recovered	124,650
Refined primary lead produced in the United States:	
From domestic ores	476,849
From foreign ore and base bullion	52,808
Lead content of antimonial lead ores treated at regular smelters from foreign and domestic sources	10,502

The secondary lead recovered in 1920 amounted to about 2 per cent more than in 1919. The secondary lead recovered as pig lead increased 666 tons, and the secondary pig lead recovered by those smelters whose product is mainly primary metal increased 242 tons. The quantity of secondary lead recovered in alloys increased 1,884 tons. A portion of the lead recovered from alloys was derived from old babbitt, solder, type metal, and white metal drosses. The main sources of secondary pig lead are old pipe, lead cable, battery plates, and lead lining of acid tanks. Regular smelters reported the recovery of 2,687 tons of lead in scrap antimonial lead, or 531 tons more than in 1919. It is stated that the manufacturers of toys consume a large quantity of impure and very low-grade lead scrap.

The use of lead in batteries has expanded rapidly with the increase in the automotive industry, and a large part of the secondary lead now recovered is obtained from old batteries.

The total output of secondary lead was equal to about 23.5 per cent of the refined primary lead produced in the United States in 1920, compared with 25.3 per cent in 1919. It was exceeded by the output of primary domestic lead in only two States—Missouri and Idaho.

SECONDARY ZINC.

Secondary zinc recovered in 1920.

	Short tons.
Zinc recovered by redistillation	21,371
Zinc recovered by remelting, sweating, etc	21,479
Total zinc recovered unalloyed	42,850
Zinc recovered in alloys other than brass	7,650
Zinc recovered in brass (estimated)	65,000
Zinc dust made from zinc dross	1,179
Zinc dross used for zinc dust (estimated)	1,400
Lithopone made from zinc skimmings and ashes	57,849
Zinc dross and skimmings exported	2,445

The output of secondary zinc (including that in brass) in 1920 equaled 24.9 per cent of the output of primary zinc in the United States, against 23.3 per cent in 1919. The recovery was 7,096 tons more than in 1919, mainly owing to the larger quantity of zinc contained in brass and other alloys recovered, though the recovery from scrap zinc, dross, and skimmings increased 2,940 tons.

Only one smelter—in New Jersey—treated zinc drosses and skimmings by means of large graphite retorts of 600 to 800 pounds capacity instead of the small clay retorts used by smelters treating ore or mixed ore and drosses. The many uses of zinc drosses and skimmings create active competition for their purchase. Considerable zinc is recovered by sweating, and the residues are sold for redistillation.

The production of zinc from drosses and skimmings made by smelters by redistillation was about 1,623 tons more in 1920 than in 1919. This increase was due in part to the stopping of the redistillation of the low grades of zinc in order to meet the demand for zinc suitable for brass.

The zinc recovered in alloys other than brass amounted to 7,650 tons, compared with 6,062 tons in 1919. Of the secondary zinc recovered unalloyed, nearly half was obtained by redistillation from drosses and skimmings and the remainder by sweating and remelting. In addition to the 42,850 tons of remelted and redistilled zinc, 57,849 tons of the zinc pigment lithopone (containing approximately 22 per cent zinc sulphide and oxide) was made from zinc skimmings and ashes. The zinc used in making zinc chloride is derived largely from zinc ashes and skimmings, and it is estimated that the zinc content of skimmings and ashes used for lithopone was 11,536 tons, and the quantity used for chloride was in excess of that used for lithopone. The export of zinc drosses, which amounted to 5,123 tons in 1919, decreased to 2,445 tons in 1920. The zinc recovered in brass increased from about 62,432 tons in 1919 to 65,000 tons in 1920.

Two plants in San Francisco are making zinc dust from zinc dross, so that all that material has a good market; but none of the secondary plants on the Pacific coast treat zinc ashes or skimmings, and it is necessary to ship them to eastern plants for treatment. The high-grade zinc dust is used largely at domestic and foreign gold and silver mines to precipitate the metals from cyanide solutions.

SECONDARY ANTIMONY.

Secondary and primary antimony recovered in 1920.

	Short tons.
Antimony recovered (mainly in alloys)	5,600
Antimony imported as metal, in ore, or as oxide or salts	12,172
Antimony produced from domestic antimony ores	None.
Antimony content of antimonial lead ores from domestic and foreign sources treated at regular lead-ore smelters in 1920	2,033

The production of secondary antimony, of which all but 200 tons was recovered in alloys, increased more than 27 per cent in 1920. The value assigned is arbitrary and is based on the average yearly price for ordinary brands of antimony published by the American Metal Market. The regular smelters reported the recovery of 428 tons of antimony contained in 3,115 tons of antimonial lead scrap. The principal materials refined or remelted which contained antimony as an alloy were hard-lead drosses, babbitt, battery plates, solder, pewter, and type metal. Antimony used in the rubber, glass, enamel, paint, and ceramic industries does not yield any secondary recoveries. The quantity of antimony used for coloring rubber and for pigments has materially increased in the last four years. The imports of antimony as metal in ore or as oxide or salts in 1920 amounted to 12,172 short tons, and the recovery from secondary sources was equal to 46 per cent of the imports. There was no reported production of antimony from domestic antimony ore in 1920.

SECONDARY TIN.

Secondary tin recovered in 1920, with imports and domestic production.

Tin recovered as pig tin	short tons	7,200
Tin recovered in alloys and chemical compounds	do	16,300
		23,500
Clean tin-plate scrap treated, including 6,436 long tons imported	long tons	154,804
Old tin-coated containers treated	do	1,725
Metallic tin recovered at detinning plants	pounds	2,167,200
Tin content of tin tetrachloride, tin bichloride, and tin oxide made by detinning plants	pounds	3,412,000
Total tin recovered at detinning plants	do	5,579,200
Tin tetrachloride, tin bichloride, and tin oxide made at detinning plants	pounds	7,578,722
Average quantity of tin recovered per long ton of old tin-coated containers	pounds	25.3
Average quantity of tin recovered per long ton of clean tin-plate scrap	pounds	35.75
Tin imported as metal in 1920	short tons	62,795
Tin concentrates imported	do	34,325
Tin derived from domestic ores in 1920	do	20
Percentage of secondary tin recovered to tin imported as metal, in ore, or as oxide		27.8

Although the United States consumes more than 50 per cent of the world's output of tin, apparently only 20 tons of metallic tin was derived from domestic mines in 1920.

The secondary tin recovered decreased from 24,033 tons, valued at $29,868,200, in 1919, to 23,500 tons, valued at $22,705,700, in 1920, or about 28 per cent of the tin imported as pig metal or in concentrates into the United States during the year (83,665 short tons). The value of the recovered tin here assigned is arbitrary and is based on the yearly average price (48.31 cents) for 99 per cent metal, with prompt delivery at New York, given by the American Metal Market. The secondary tin in alloys decreased 1,756 tons, and the secondary pig tin increased 1,223 tons.

Nearly all clean tin-plate scrap is detinned by one of three processes—the electrolytic alkali, the chlorine, or the alkali saltpeter.[3]

The recovered tin in alloys included the tin content of products made in several plants from clean tin-plate scrap and old tin-coated cans. This included some tin oxide and putty powder but consisted mainly of tin tetrachloride and tin bichloride. The production of these compounds is calculated as metal and not separately stated, in order to avoid disclosing confidential information. As the products are made from scrap tin and thus conserve the primary metal, they are properly regarded as recovered tin.

The largest recoveries of tin were made from the scruff and drosses that occur in making tin plate and terneplate and amounted to more than 5,600 tons. The quantity of tin plate and terneplate made in 1920 was about 200,000 long tons more than in 1919.

About 2,790 tons of tin was recovered from clean scrap tin plate, either as pig tin or as tin chloride or tin oxide. Apparently only about 500 tons of pig tin was recovered from scrap tin (not tin plate), clippings, old tin pipe, tin foil, and collapsible tubes, and it is impossible to give separately the quantities of tin recovered from these sources. Old block-tin pipe is most acceptable scrap, but the quantity available is steadily declining.

Nearly all the tin-plate scrap imported in 1920 came from Canada.

Tin-coated scrap and old cans are frequently utilized in western mining regions for their iron content in the precipitation of copper from mine waters; the tin coating, however, is wasted. No old cans are detinned in the Western States, and nearly all the clean tin-plate scrap from can-making plants is shipped to eastern plants under yearly contracts. A small portion of the clean tin strips cut from sheets is sold to makers of boxes and baskets and is used to bind, strengthen, or fasten the tops of the containers made. The Metal & Thermit Co. has completed in 1921 a plant at San Francisco for treatment of scrap tin plate which formerly was shipped to eastern plants.

A large quantity of tin was recovered in bronze, and part of the brass remelted contains a little tin and lead, which in the aggregate amounts to a considerable quantity. Other alloys from which secondary tin was recovered were solder, babbitt, pewter, terne metal, and electrotype metal.

From reports received by the Geological Survey the clean tin-plate scrap detinned in 1920 was about 22,000 tons less than in 1919. Metal and tin chloride containing altogether 43,600 pounds of tin

[3] A short history of the detinning industry: Met. and Chem. Eng., August, 1917, pp. 187–189.

was recovered from the old tin-coated cans. The average metallic content of the tin oxide was given as 78.9 per cent, that of the tin bichloride as 24.5 per cent, and that of the tin tetrachloride as 45.4 and 46 per cent.

The relatively small quantity of secondary tin recovered from tin-plate scrap and old tin-coated cans is significantly shown when compared with the quantity of tin used in making tin plate. It is estimated that 28,000 tons of tin was used by makers of tin plate in 1920 and that the total recovery of tin as metal and in compounds from tin-plate scrap and old cans was 2,790 short tons, and that of this quantity only 22 tons was obtained from old cans.

A small quantity of old cans was used by makers of window-sash weights from which no tin was recovered, but more than 99 per cent of all the old cans utilized in 1920 were treated by the dry chlorine process at plants in New Jersey and at East Chicago, Ind., owned by the Metal & Thermit Co., and by the electrolytic process at plants at Sewaren, N. J., and Streator, Ill., owned by the Vulcan Detinning Co. The cans purchased were classified as follows:

Class 1. Unused empty and unrusted tin cans not exceeding the 1-gallon size, with or without labels attached but otherwise free from foreign material such as ice, water, ashes, paint, varnish, white lead, and similar insoluble (in water) contents.

Class 2. Used cans not exceeding the 1-gallon size and otherwise as described in class 1.

Class 3. Used empty and unrusted tin cans exceeding in size the 1-gallon size, but not exceeding the 5-gallon size and otherwise as described in class 1.

During 1920 the quoted prices for old tin cans were $9.50 to $10 a long ton (2,240 pounds) delivered at Sewaren, N. J., Chrome, N. J., and East Chicago, Ind.

A description of the method used in treating old tin-coated cans is given in this report for 1919.

New tin-plate clippings were treated at the above-named plants that treated old cans and also by the Johnson & Jennings Co., of Cleveland, Ohio, and the Republic plant of the Vulcan Detinning Co., at Pittsburgh. The companies named are the only ones in the United States that reported the detinning of tin-plate scrap or used tin-coated containers.

The plants utilizing old tin cans have never received shipments large enough to operate steadily at full capacity, even when the prices of tin and black sheet-steel scrap were 50 per cent higher than those prevailing in 1920. The increased cost of cartage and freight has made it unprofitable for collectors of waste material to segregate and ship old cans, so that many contracts with detinning companies were not renewed in 1919 and 1920. The detinning companies have reduced the price paid for old cans because their expenses of operating have increased and tin has declined to less than 30 cents a pound in 1921, and bundled black-plate scrap brings less than $6 a long ton. The supply of tin chloride, which is made almost entirely from scrap and which is the main product of detinning plants, is ample since war uses have ceased.

The detinning plants treating old cans can handle more than 25,000 tons of cans a year—about 14 times the quantity treated in 1920—and it is doubtful if the consumption in 1921 will be more than 5 per cent of that capacity. The supply of used cans has been steadily decreasing as contracts expired, and this will necessitate the closing of some plants, for the margin of profit is small, and steady

operation is required to make any profit. Old tin cans selling for $8 to $9 a long ton delivered at detinning plants bring the shipper only $2 to $3 a long ton after loading and freight charges are paid. The doom of the detinning of old cans is sure unless municipalities so regulate the collection of garbage that the cans must be segregated by the householder, clean and dry, ready to be shipped by rail without any sorting. The collection of tin foil and old collapsible tubes largely by persons and organizations for charitable purposes has also become less effective, because much of the foil and many other containers are either not now made from tin or contain only a small quantity of tin.

Although there is now a supply of tin sufficient for all requirements at less than pre-war prices, there are two good reasons for restricting its use to the lowest point. One is that the supply of new tin is derived almost entirely from foreign sources, and the other is that tin is a relatively high-priced metal and the use of substitutes giving approximately equal efficiency radically reduces the cost of many alloys, such as solder, babbitt, and other bearing metals.

SECONDARY ALUMINUM.

Secondary aluminum recovered in 1920, with imports and domestic production.

Secondary aluminum recovered.....short tons..	5,000
Aluminum recovered in alloys (mainly No. 12).....do....	10,500
	15,500
Value of primary aluminum produced in the United States in 1920	$41,375,000
Aluminum (crude and semicrude) imported for consumption.....pounds..	39,298,649
Aluminum exported as pig aluminum, plates, and sheets, ...pounds..	9,407,631

The recovery of secondary aluminum as pig aluminum or in alloys in 1920 amounted to 15,500 short tons, valued at $9,489,100, compared with 18,691 tons, valued at $12,014,600, in 1919.

Some of the larger secondary smelters and refiners of aluminum in 1920 were the Peninsular Smelting Co., Detroit, Mich.; Michigan Smelting & Refining Co., Detroit, Mich.; United Smelting & Aluminum Co., New Haven, Conn.; United States Reduction Co., East Chicago, Ind.; Great Western Smelting & Refining Co., St. Louis, Mo.; Cleveland Electro Metals Co., Cleveland, Ohio; Loewenthal Co., Chicago, Ill.; National Smelting Corporation, Cleveland, Ohio; W. F. Jobbins Co. (Inc.), Aurora, Ill.

Various products are made by smelters and refiners from scrap aluminum.

Robert J. Anderson [4] says that "the average recovery from light alloy borings and related scrap is stated to be 65 to 70 per cent and the recovery from dross containing 30 to 60 per cent metallics not more than 80 per cent of the contained metal."

Approximately 97 per cent of the aluminum used in alloys is in No. 12 alloy, containing 92 per cent of aluminum and about 8 per cent of copper, though it usually has an iron content of approximately 1 per cent. Other metals alloyed with aluminum are magnesium, zinc, tin, and manganese, but the total quantity of alloys made from aluminum and these metals is very small compared with the alloys of

[4] Losses in aluminum and aluminum alloy melting: Brass World, June, 1921, pp. 154–156.

aluminum and copper in various proportions. A large quantity of No. 12 secondary ingots is made by smelters from old or defective castings, borings, and scrap, as is shown by the fact that the secondary recovery of aluminum in alloys was more than double that recovered unalloyed in 1920.

The following articles on aluminum were published in the report for 1919 on secondary metals:

Casting losses in aluminum foundry practice in the United States, by Robert J. Anderson.

Scrap aluminum, by Charles Vickers.

Tentative specifications for aluminum presented to the American Society for Testing Materials.

SECONDARY NICKEL.

Secondary nickel recovered in 1920, with imports and domestic production.

	Short tons.
Nickel recovered as metal	270
Nickel recovered in nonferrous alloys and salts	1,930
	2,200
Nickel produced from ore mined in Missouri and as a by-product from the electrolytic refining of copper at domestic refineries	365
Nickel imported for consumption in the United States as nickel or in nickel ores and matte, oxide, and alloys	24,246

The nickel recovered from secondary sources in 1920 includes nickel in monel metal, but not that in ferrous alloys. Most of the nickel in matte, oxide, ore, etc., imported came from the Sudbury district, Ontario. The nickel-copper matte imported is partly refined and partly smelted to make monel metal.[5] A considerable quantity of nickel was recovered at the refinery of the Missouri Cobalt Co., at Fredericktown, Mo., from ores that contain nickel, lead, copper, and cobalt.

Of the refined nickel produced, about 60 per cent is used in nickel steel, 30 per cent in white-metal alloys, 5 per cent in anodes for plating, and 5 per cent for miscellaneous purposes, including the manufacture of salts and other chemical compounds.

As nickel is used chiefly as an alloy in steel and as the secondary recoveries of nickel reported to the Geological Survey in 1920 were obtained solely from nonferrous scrap, it is evident that the 2,200 tons of nickel reported forms only a small portion of the nickel in alloys recovered and reused. The secondary nickel reported in 1920 was nearly all recovered from old nickel anodes, nichrome, nickel silver, and monel metal. A nickel alloy which is now being more generally used is composed of about 60 per cent nickel and the remainder mainly chromium. The properties and uses of this alloy, called "nichrome," are described in an article recently published.[6] Extracts from this article are given in the report on secondary metals in 1919.

Analyses of various nickel alloys have already been published by the United States Geological Survey.[7]

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[5] Begman, Adolf, Methods of melting and casting, uses, etc., of monel metal: Metal Industry, vol. 19 pt. 1, pp. 9–10; pt. 2, pp. 64–65.

[6] Equipment for foundry and plating room: Brass World, vol. 16, pp. 146–147, May, 1920.

[7] Hess, F. L., Nickel: U. S. Geol. Survey Mineral Resources, 1915, pt. 1, pp. 763–765, 1917.

SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES.[1]

(MINES REPORT.)

By J. P. Dunlop and F. Begeman.

INTRODUCTION.

The silver, copper, lead, and zinc mines of the Central States are in Arkansas, Illinois, Kansas, Kentucky, Michigan, Missouri, Oklahoma, and Wisconsin. The territory thus embraced lies in the great interior valley province of the United States, which extends from the Appalachian system to the Rocky Mountain front, exclusive of the Black Hills. Most of the mines are in the Paleozoic sedimentary rocks of this province, but the copper range of northern Michigan comprises lavas and intercalated sediments of pre-Cambrian age.

In the lead and zinc regions of the Central States the material sold is principally concentrates,[2] and payment is made according to a basic price for concentrates of a certain quality. The details of this method are given in the pages devoted to Missouri in this report for 1914. The figures reported to the Geological Survey by producers represent the quantity and assay content of concentrates sold and the amount received in payment. The total metal produced is calculated from the first two of these items.

The operators in Michigan report the quantity of concentrates produced and the actual recovery of copper from concentrates smelted.

In any year the mines may produce more or less concentrates than are smelted during the same period. The copper content of concentrates produced but not smelted during the year has been estimated on the basis of the average copper recovery per ton for the year of the company producing it.

TENOR OF LEAD AND ZINC ORES OF THE CENTRAL STATES.

Much of the ore mined in the Western States is crude smelting ore—that is, it can be smelted directly without preliminary concentration. All but a very small portion of the ore from the Central States is of such tenor that it requires concentration. The only fair basis for comparison of the relative magnitude of mining operations in different States is that of quantity of crude ore, or "dirt." In Kentucky and southern Illinois the lead and zinc concentrates are recovered as by-products in the concentration of the fluorspar which they accompany, and it was not possible to make calculations of the metal content of the crude ore raised.

[1] A bibliography is given in Mineral Resources for 1919 and some preceding volumes.

[2] In local usage the ore as mined is called "dirt" and the concentrates are classed as "ore." Where the capacity of a concentrating plant is given, such capacity is to be understood as based on a 10-hour shift unless otherwise stated.

Quantity and tenor of copper, lead, and zinc ores of Central States, 1918–1920.

State.	1918		1919		1920	
	Crude ore.	Metal content.[a]	Crude ore.	Metal content.[a]	Crude ore.	Metal content.[a]
	Short tons.	*Per cent.*	*Short tons.*	*Per cent.*	*Short tons.*	*Per cent.*
Arkansas	37,000	3.18	5,800	4.20	9,800	3.81
Illinois (northern)	280,900	2.10	404,000	2.47	312,000	2.13
Kansas	1,025,400	3.97	1,391,600	4.61	1,704,700	4.96
Michigan	11,321,365	1.00	7,690,253	1.10	5,938,967	1.18
Missouri	9,146,800	2.80	[b] 5,690,730	3.49	6,108,030	3.15
Oklahoma	5,754,700	4.11	6,168,200	3.76	6,943,100	4.46
Wisconsin	2,377,300	2.80	1,826,200	2.95	1,742,000	2.08
	29,943,465	.....	23,176,783	.....	22,758,597	.....

[a] The percentages given in this column represent the metal content of the ore in so far as it is recovered in the concentrates. In Michigan the metal so recovered is copper, in the other Central States the metals are lead and zinc, the relative proportions of which are shown in the table on another page and in the tables of tenor of ore given in the sections devoted to the respective States.

[b] 57,000 tons of cobalt-nickel-copper ore excluded.

This table shows that there was a decrease of about 418,000 short tons in the quantity of ore from the copper, lead, and zinc mines of the Central States treated in 1920. The production of ore from the copper mines of Michigan decreased 1,751,000 tons, and the production of lead and zinc ores in Missouri increased 417,300 tons. The mines of the disseminated lead district in southeastern Missouri increased their output 501,700 tons. Other States which had an increased output of lead and zinc ore in 1920 were Oklahoma, 774,900 tons; Kansas, 313,100 tons; and Arkansas, 4,000 tons. The decreases in 1920 in other States were as follows: Illinois, 92,000 tons; Wisconsin, 84,200 tons.

The low average tenor of the crude ore mined in the Central States in 1920 is best shown by the fact that the average value of the total recoverable metal content was only $5.46 a ton of crude ore treated and that although this value was 99 cents more than in 1919, the increase was due to the higher price of lead and zinc. The 16,819,630 tons of zinc, lead, and lead-zinc ores treated in the Central States in 1920 yielded lead and zinc concentrates which sold for $58,883,727, so that the mine operators realized an average of $3.50 a ton of ore mined and treated, against $2.75 a ton in 1919. Both the quantity and the value of lead and zinc concentrates and also the value of both metals were more in 1920 than in 1919. There were substantial increases in the mining and milling costs, so that many mines were operated without a profit, especially during the last part of 1920.

PRODUCTION.

The total value of the mine production of silver, copper, lead, and zinc in the Central States in 1920 increased 20 per cent compared with the value for 1919. The total value of the mine production of these metals for the years 1907 to 1920, inclusive, was $1,370,985,642—$540,687,495 for copper, $496,228,674 for zinc, $328,911,422 for lead, and $5,158,051 for silver. Only in 1915, 1916, 1919, and 1920 has the value of the recoverable zinc exceeded that of the copper, and in 1920 for the first time the value of the lead exceeded that of copper.

SILVER.

Nearly all the silver that has been produced in the Central States was recovered incidentally in the production of other metals. The output in 1920 from the copper lodes of Michigan showed an increase of 28,759 ounces. About 37 per cent of the concentrates from lead ores mined in southeastern Missouri was desilverized and yielded most of the silver from that State recovered in 1920, and 28,664 ounces of silver was derived from nickel-cobalt-copper ore.

The lead-zinc-fluorspar deposits of the Kentucky-Illinois field also carry silver, and the silver recovered from the lead concentrates from Illinois was 8,193 ounces, an increase of 3,753 ounces.

COPPER.

The mine production of copper in the Central States in 1920 came from Michigan and Missouri. The copper production of Michigan, which, as in other years, contributed nearly the entire output, was 24,131,413 pounds less than in 1919. The copper produced in Missouri was derived mainly from ore mined by the Missouri Cobalt Co. in Madison County.

The total mine production of copper from Michigan and Missouri in 1920 was about 117,900,000 pounds less than in 1916.

LEAD.

The mine production of lead in the Central States in 1920 showed an increase of more than 7 per cent. Missouri produced 65.6 per cent of the yield, against 70 per cent in 1919, and the recoverable lead content of galena and lead carbonate concentrates mined in Missouri equaled 35 per cent of the refined primary lead recovered in the United States from domestic ore. Of the total output of lead in Missouri the disseminated lead district of southeastern Missouri produced 161,077 tons, an increase of 4,401 tons, and again exceeded the Coeur d'Alene district of Idaho and retained first place in production of lead in the United States. Small lead mines and a barytes mine in southeastern Missouri reported the recovery of 181 tons of lead. Southwestern Missouri had an output of 3,856 tons, or 2,276 tons less than in 1919. The production in Oklahoma increased from 53,872 tons in 1919 to 65,394 tons in 1920, and the output of the Miami district (in Oklahoma) in 1920 was nearly three times as large as the combined output of all regions of the Central States other than southeastern Missouri.

The production from Kansas mines increased from 11,283 tons in 1919 to 16,788 tons in 1920; Illinois decreased from 2,105 to 1,743 tons, and Wisconsin from 4,214 to 2,647 tons. The total production of lead from mines in the southern Illinois-Kentucky region, Arkansas, and the upper Mississippi Valley amounted to only 1.8 per cent of the output of the Central States.

ZINC.

The figures showing production of zinc in the Central States in 1920 are based on mine returns, with a deduction for separating and smelting losses. The value is computed at 8.1 cents a pound ($162

a ton), the average price reported by the smelters for all grades of the metal.

The output in 1920 was the largest recorded yield from mines in the Central States, being more than that of the year 1917 by 27,181 tons. This gain was due entirely to increases in Kansas of 13,437 tons and in Oklahoma of 41,317 tons. The production of zinc in the Central States was about 75 per cent of the total production of primary zinc from domestic ores in the United States, against 67.5 per cent in 1919.

The production of zinc in Oklahoma exceeded that of Missouri by about 195,000 tons. For many years until 1917 Missouri had been the largest producer of zinc in the United States, but the output has decreased from 132,918 tons in 1917 to 24,509 tons in 1920, while that of Oklahoma has increased from 85,835 to 219,727 tons. Moreover, both Kansas and Wisconsin exceeded Missouri in 1920. Arkansas increased in output from 189 to 329 tons; Kentucky decreased from 36 tons to 9 tons; northern Illinois decreased from 6,788 to 4,720 tons. No production of lead or zinc was reported from Iowa mines in 1920.

Mine production of silver, copper, lead, and zinc in the Central States in 1920, by States.

State.	Silver.		Copper.	
	Quantity (fine ounces).	Value.	Quantity (pounds).	Value.
Illinois	8,193	$8,930		
Michigan	470,189	512,506	154,695,073	$28,463,893
Missouri	111,128	121,130	1,512,539	278,307
	589,510	642,566	156,207,612	28,742,200
Total, 1919	536,271	600,624	180,443,686	33,562,525

State.	Lead.		Zinc.		Total value.
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	
Arkansas	8	$1,280	329	$53,298	$54,578
Illinois	1,743	278,880	4,720	764,640	1,052,450
Kansas	16,788	2,686,080	61,073	9,893,826	12,579,906
Kentucky	122	19,520	9	1,458	20,978
Michigan					28,976,399
Missouri	165,114	26,418,240	24,509	3,970,458	30,788,135
Oklahoma	65,394	10,463,040	219,727	35,595,774	46,058,814
Wisconsin	2,647	423,520	27,285	4,420,170	4,843,690
	251,816	40,290,560	337,652	54,699,624	124,374,950
Total, 1919	234,878	24,897,068	305,364	44,583,144	103,643,361

PRODUCTION OF LEAD AND ZINC, BY REGIONS.

The productive lead and zinc territory in the Central States naturally falls into seven regions, three of which are not limited to a single State. For statistical purposes the tables showing the production of lead and zinc by States are necessary and are so given. For practical purposes, however, it is desirable to show the production by the natural regions irrespective of State lines.

The seven regions are, in order of size of output: (1) the Joplin region, comprising southwestern Missouri, southeastern Kansas, and northeastern Oklahoma; (2) southeastern Missouri, containing the great deposits of disseminated lead; (3) the upper Mississippi Valley region, including all the lead and zinc mines in southwestern Wisconsin, Iowa, and northwestern Illinois; (4) the fluorspar region in southern Illinois and northern Kentucky; (5) northern Arkansas; (6) central Missouri; (7) the Arbuckle Mountain region in southern Oklahoma.

The southeastern Missouri region produced about 64 per cent of the lead output of the Central States and about 34 per cent of the primary lead recovered from domestic ore smelted or refined in the United States in 1920. The Joplin region produced 34.2 per cent of the lead and 90.4 per cent of the zinc of the Central States in 1920 and was much the largest producer of zinc in the United States, yielding about 67.8 per cent of the total zinc production from domestic ores in 1920, as against 57 per cent in 1919. The upper Mississippi Valley region produced 1.4 per cent of the lead and 9.5 per cent of the zinc in the Central States in 1920.

The lower zinc content of the zinc concentrates produced at mines in the upper Mississippi Valley region is clearly indicated by the fact that, although these mines yielded about 17.6 per cent of the total output of raw zinc concentrates of all classes, the recoverable zinc content of such concentrates was only about 9.5 per cent of the recoverable zinc from mines in the Central States.

The lead content of the galena concentrates shipped from the upper Mississippi Valley region averaged 75 per cent, that of the concentrates from the Joplin region averaged 80.2 per cent, and that of the southeastern Missouri region averaged 66.6 per cent. A very small proportion of the galena shipped from the Joplin region contained less than 76 per cent of lead, and some of the galena shipped contained more than 83 per cent of lead. A large part of the sphalerite shipped from the Joplin region contained nearly 60 per cent of zinc, and the 36,857 tons shipped from the Waco district in that region averaged about 61.7 per cent of zinc.

Mine production of lead and zinc in the Central States in 1920, by regions.

Region.	Concentrates.				Total value.
	Lead.[a]		Zinc.[b]		
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	
Joplin	107,252	$10,143,101	569,595	$25,616,563	$35,759,664
Southeastern Missouri[c]	242,248	19,799,389	61	1,910	19,801,299
Upper Mississippi Valley[d]	4,604	414,321	121,914	2,746,433	3,160,754
Kentucky-southern Illinois	1,424	131,580	25	750	132,330
Northern Arkansas	10	755	917	28,925	29,680
	355,538	30,489,146	692,512	28,394,581	58,883,727
Total, 1919	327,957	18,219,316	654,347	24,391,144	42,610,460

[a] Includes both galena and lead carbonate concentrates.
[b] Includes sphalerite, zinc carbonate, and zinc silicate concentrates.
[c] Includes a small production from the central Missouri region.
[d] Includes Iowa, northern Illinois, and Wisconsin.

Mine production of lead and zinc in the Central States in 1920, by regions—Continued.

Region.	Metal.				
	Lead.		Zinc.		Total value.
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	
Joplin	86,038	$13,766,080	305,290	$49,456,980	$63,223,060
Southeastern Missouri[a]	161,258	25,801,280	19	3,078	25,804,358
Upper Mississippi Valley[b]	3,453	552,480	32,005	5,184,810	5,737,290
Kentucky-southern Illinois	1,059	169,440	9	1,458	170,898
Northern Arkansas	8	1,280	329	53,298	54,578
	251,816	40,290,560	337,652	54,699,624	94,990,184
Total, 1919	234,878	24,897,068	305,364	44,583,144	69,480,212

[a] Includes a small production from the central Missouri region.
[b] Includes Iowa, northern Illinois, and Wisconsin.

Mineral Resources for 1914 contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State for the period 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each State before 1907.

ARKANSAS.

By J. P. Dunlop.

The value of the recoverable lead and zinc from Arkansas mines, which had increased from $801,754 in 1915 to $1,430,668 in 1917, was only $54,578 in 1920. The decrease in shipments was caused almost entirely by the lower price of zinc concentrates.

The production of galena was less than one-third of that in 1919, and the total yield was small compared with that of other regions. The shipments of zinc carbonate and zinc silicate concentrates were larger than in 1919 but were only 5.4 per cent of the shipments in 1917.

Mine production of lead and zinc in Arkansas, 1907–1920.[a]

Year.	Ores.						Metal content.			
	Lead concentrates (galena).		Zinc concentrates.				Lead.		Zinc.	
			Sphalerite.		Silicate and carbonate.					
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1907–1915	416	$22,348	8,576	$315,910	12,221	$506,842	331	$29,394	8,290	$1,362,538
1916	339	28,097	1,670	112,726	16,609	940,224	272	37,536	6,815	1,826,420
1917	474	47,593	916	57,824	17,053	650,585	382	65,704	6,691	1,364,964
1918	155	13,594	310	16,450	2,156	68,333	120	17,040	951	173,082
1919	35	2,400	.....	.....	510	18,170	28	2,968	189	27,594
1920	10	755	.....	.....	917	28,925	8	1,280	329	53,298

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses of zinc but not of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price of all grades.

Tenor of lead and zinc ore and concentrates produced in Arkansas in 1919 and 1920.

		1919	1920
Total crude ore	short tons	5,800	9,800
Total concentrates in crude ore:			
Lead	per cent	0.60	0.11
Zinc	do	8.80	9.36
Metal content of crude ore:			
Lead	do	.49	.08
Zinc	do	3.71	3.73
Average lead content of galena concentrates	do	80.0	80.0
Average zinc content of zinc silicate and carbonate	do	42.0	39.9
Average value per ton:			
Galena concentrates		$68.57	$75.50
Zinc silicate and carbonate		$35.63	$31.54

The mines are principally in Boone and Marion counties and the adjoining portions of Searcy and Newton counties, though there are also numerous mines and prospects in Baxter, Izard, Sharp, Lawrence, and other counties to the east, and deposits have been worked in Washington and Sevier counties, on the extreme western border of the State.

The ores are galena, sphalerite, and smithsonite, and the concentrates produced are generally of high grade and free or nearly free from iron or lime. The sphalerite and smithsonite are shown by analysis to contain appreciable quantities of cadmium, especially in a yellow variety of smithsonite, known locally as "turkey fat," which shows as high as 0.8 per cent of cadmium.

Some mixed sphalerite and zinc carbonate concentrates were sold, and these shipments are given under carbonate.

Most of the lead and zinc mines in Arkansas were not operated in 1920, and none of those from which concentrates were shipped were operated steadily. Most of the mines have inexpensive equipment, no water to pump, and no leases requiring steady operation, so that work could be suspended until better prices were offered for zinc ores. These conditions explain why the reduction in the output of lead and zinc from Arkansas mines was proportionately greater than in the other regions of the Central States.

The estimated quantity of ore treated increased from 5,800 tons in 1919 to 9,800 tons in 1920, and the average recovery of concentrates from such ore increased from 9.4 per cent to 9.5 per cent.

Only three mines yielded more than 100 tons of concentrates, and the entire production came from mines worked on a small scale.

Mines in Marion, Searcy, and Newton counties produced all the zinc concentrates shipped in 1920, and mines in Newton County produced all the galena concentrates. The shipments from Searcy County were 340 tons of zinc carbonate, about 260 tons more than in 1919, and were mainly from the Hurricane mine. A description of the mining properties near Zinc, in Boone County, was recently written by Tom Shiras.[2] Some of the mines were operated in 1920, but the output was stored.

From the Bald Hill mine, in the Cave Creek district, in the eastern part of Newton County, and from mines in the Ponca and Jasper districts, in the western part, were shipped 10 tons of galena and 327 tons of zinc carbonate.

[2] Shiras, T., Operations at the Zinc camp, Ark.; Eng. and Min. Jour., Apr. 5, 1919, pp. 607-608.

The total shipments from mines in Marion County in 1920 amounted to 250 tons of zinc carbonate concentrates, which was 102 tons less than in 1919.

The mines at Rush, which were large producers in 1917, shipped only about 250 tons of zinc carbonate in 1920. Among the producing properties were the Loney Boy and Edith.

In addition to carbonate concentrates in stock at Zinc at the end of 1920, there were accumulations of carbonate ore at the Bald Hill, Spear, and Big Joe mines, and at shipping points for the small prospects on Cow Creek in Marion County.

ILLINOIS.[2a]

By J. P. Dunlop.

PRODUCTION.

Mine production of lead and zinc in Illinois in 1920 by districts.[a]

District.	Ores.				Metal content.			
	Lead concentrates (galena).		Zinc concentrates (sphalerite).		Lead.		Zinc.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Northern Illinois	1,078	$87,544	17,984	$396,251	806	$128,960	4,720	$764,640
Southern Illinois	1,252	119,285	.....	.....	937	149,920	.....	.....
	2,330	206,829	17,984	396,251	1,743	278,880	4,720	764,640
Total, 1919	2,874	181,199	25,034	491,579	2,105	223,130	6,788	991,048

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses of zinc, but not of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price of all grades.

Tenor of lead and zinc ore and concentrates produced in Illinois, 1919 and 1920.

		1919	1920
NORTHERN ILLINOIS.			
Total crude ore	short tons	404,000	312,000
Total concentrates in crude ore:			
Lead	per cent	.53	.35
Zinc	do	6.19	5.77
Metal content of crude ore:			
Lead	do	.40	.26
Zinc	do	2.07	1.87
Average lead content of galena concentrates	do	74.5	74.8
Average zinc content of sphalerite concentrates	do	33.5	32.4
Average value per ton:			
Galena concentrates		$63.51	$81.21
Sphalerite concentrates		$19.63	$22.03
SOUTHERN ILLINOIS.			
Average lead content of galena concentrates	per cent	70.0	74.7
Average value per ton of galena concentrates		$61.66	$95.27

[2a] Mineral Resources for 1914 contains a historical review of lead and zinc mining in Illinois.

Mine production of silver in southern Illinois, 1907–1920.

Year.	Silver.		Lead concentrates, silver bearing.		Year.	Silver.		Lead concentrates, silver bearing.	
	Quantity (fine ounces).	Value.	Quantity (short tons).	Ounces of silver per ton.		Quantity (fine ounces).	Value.	Quantity (short tons).	Ounces of silver per ton.
1907-1915.	25,220	$14,371	4,199	6.00	1918.....	8,171	$8,171	1,228	6.65
1916.....	5,684	3,740	874	6.50	1919.....	4,440	4,973	715	6.16
1917.....	7,186	5,921	1,239	5.80	1920.....	8,193	8,930	1,252	6.55

The value of the mine production of silver, lead, and zinc in Illinois in 1920 was $1,052,450, as compared with $1,219,151 in 1919.

The lead and zinc deposits of Illinois fall into two distinct regions marked by different mineral association and structural environment. Those of southern Illinois belong to the Kentucky-Illinois fluorspar district; those of northern Illinois belong to the upper Mississippi Valley region.

NORTHERN ILLINOIS.

The lead and zinc mines of northern Illinois are all in Jo Daviess County, the extreme northwestern county of the State. The ores are galena, smithsonite, and sphalerite, though the first two are much less common now than formerly, when the deposits worked were mostly shallow and above water level.

Although the lead output of northern Illinois, Wisconsin, and Iowa has been large in the past, and the ores have been smelted near the mines,[3] the output in recent years has been comparatively small and no ores have been smelted in those States.[4] The galena is practically nonargentiferous, and the zinc ores are not known to contain cadmium. Iron pyrite is very commonly associated with the ores, generally in such quantity as to necessitate roasting and magnetic separation.

The entire output of northern Illinois is included under the Galena district, which comprises the mines from the vicinity of Fever River to the Wisconsin State line.

The production of lead concentrates was 1,078 tons, a decrease of 1,081 tons from 1919, and of sphalerite concentrates, 17,984 tons, a decrease of 7,050 tons. The crude ore mined decreased from 404,000 tons in 1919 to 312,000 tons in 1920. The average recovery of zinc concentrates from the ore milled decreased 0.42 per cent, and the percentage of lead was less than in 1919. The average zinc content of the sphalerite concentrates decreased from 33.5 to 32.4 per cent.

The largest quantity of zinc concentrates in northern Illinois was derived from the old Marsdon-Black Jack mine of the Mineral Point Zinc Co. The North Unity mine, of the Vinegar Hill Zinc Co., was the second largest producer of sphalerite and the largest of galena concentrates, and the Blewett mine was the third largest producer of sphalerite. The Osborne sublease, on the Graham land, had a good production of lead taken from levels opened by shafts 45 to 60

[3] Cox, G. H., Lead and zinc deposits of northwestern Illinois: Illinois Geol. Survey Bull. 21, p. 14, 1914.
[4] Pulsifer, H. B., History of lead smelting in Wisconsin: Min. and Eng. World, May 2, 1914, p. 821.

feet in depth. The Graham mine, of the Vinegar Hill Zinc Co., had an output of sphalerite before it was abandoned as worked out.

The only new operations in 1920 were those by A. Hollander, who milled old tailings at the Unity mine, and by T. Kohlmann, who milled tailings at the abandoned Vinegar Hill mine.

SOUTHERN ILLINOIS.

The lead and zinc deposits of southern Illinois are found in Pope and Hardin counties in rocks of Mississippian age in the northern extension of the Kentucky-Illinois fluorspar district. The principal product of the mines in recent years has been fluorspar, and the yield of galena is small compared with the output from other districts in the Central States, though larger than the output from northern Illinois in 1920. The total production of galena concentrates for southern Illinois from 1906 to 1920 has been 9,710 tons, most of which has been shipped from the Fairview and Rosiclare mines. The shipments of zinc ores from the district have been comparatively small and scattered. The only recorded shipments of zinc carbonate, aggregating 103 tons, were made from the Empire mine in 1903 or 1904 and from four companies in 1916.

The structural relations and mineralogic association are similar to those of the deposits of western Kentucky and in striking contrast to those of the deposits of northern Illinois. The ores occur in fissure veins, in association with joints and faults. The mines have been worked to depths of 500 feet without disclosing any decrease in the dimensions of the ore bodies. Dikes and sheets of lamprophyre and dikes of mica peridotite occur in the vicinity, but not in direct connection with the ore deposits. Galena is the most important metallic mineral. Formerly, and nearer the surface, large bodies of galena were worked, but galena is now produced incidentally in the concentration of the fluorspar. For this reason it would be misleading to give the quantity of crude ore.

The galena of southern Illinois is notably argentiferous as compared with the rest of the Mississippi Valley ores, the silver content being as much as 14 fine ounces per ton of lead concentrate and averaging for the last seven years from 5 to 7 ounces per ton of lead concentrate. Sphalerite, or zinc blende, is the next important metallic mineral, but it occurs much less plentifully than galena. It is recovered as zinc middlings in the concentration of the fluorspar. The difficulty of making a clean separation of the zinc middlings has kept down the production of zinc. None has been sold from southern Illinois in the last 11 years. The principal vein minerals are fluorspar, calcite, and barite.

The shipments of galena concentrates increased from 715 tons in 1919 to 1,252 tons in 1920, and the silver content recovered in treating the concentrates increased from 4,440 to 8,193 ounces. The average lead content of the concentrates was 74.7 per cent in 1920. The average silver content per ton recovered from lead concentrates increased from 6.16 to 6.55 ounces.

The Fairview Fluorspar & Lead Co., which was much the largest producer of galena, operated on the Good Hope vein, which was first developed in 1862. Four shafts were operated at the 200 and 500 foot levels in 1920. The concentrating plant, which has a capacity

of about 20 tons an hour, was equipped with four new tables and an extra jig. The Blue Diggings mine was abandoned in March, and the Good Hope workings were unwatered and developed.

The Rosiclare Lead & Fluor Spar Mining Co. operates on an ore body which is probably continuous with that of the Fairview. The fireproof steel and concrete mill is designed to handle 500 tons a day and is provided with special facilities for saving the lead and zinc both by jigs and by tables. Small shipments of galena containing silver were made from prospects in the Shawneetown district, and the Hillside Fluor Spar & Lead Mining Co. was opening a new mine and constructing a concentrating plant near Rosiclare.

IOWA.

By J. P. Dunlop.

The lead and zinc deposits of Iowa extend along Mississippi River for nearly 80 miles, in Dubuque, Clayton, and Allamakee counties. They are found in the Galena dolomite, of Ordovician age.

In early days the Dubuque mines were the most important source of lead in the United States, and in later years the mines, especially those in the vicinity of Durango, yielded considerable quantities of zinc-carbonate ore.

The ore deposits of the Dubuque district occur in crevices and in caves or "openings" along these crevices. Of these openings there are five or six, the "top," "middle," and "third" being the most prolific of ore. The "flats" and "pitches," common in the Wisconsin mines, have been found in only one or two places in Iowa.

No shipments of lead or zinc concentrates from mines in Iowa were reported in 1919 or 1920.

KANSAS.

By J. P. Dunlop.

Mine production of lead and zinc in Kansas, 1920, by districts.[a]

District.	Ores.			
	Lead concentrates (galena).		Zinc concentrates (sphalerite).	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Badger-Peacock	723	$73,675	1,884	$76,958
Lawton-Waco (in Kansas)			15,777	742,275
Blue Mound-Baxter Springs	19,831	1,909,649	94,565	4,289,424
Galena	277	22,193	922	45,915
Total, 1919	20,831	2,005,517	113,148	5,154,572
	14,024	957,421	87,956	3,901,260

[a] In calculating the metal content of the ores from assays, allowance has been made for smelting losses of zinc but not of lead. In comparing the values of ore and metal it should be borne in mind thatt he value given for the ore is that actually received by the producer, while the value of the lead and zinc is calculated from the average price for all grades.

Mine production of lead and zinc in Kansas, 1920, by districts—Continued.

District.	Metal content.			
	Lead.		Zinc.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Badger-Peacock	590	$94,400	983	$159,246
Lawton-Waco (in Kansas)			8,740	1,415,880
Blue Mound-Baxter Springs	15,997	2,559,520	50,887	8,243,694
Galena	201	32,160	463	75,006
Total, 1919	16,788	2,686,080	61,073	9,893,826
	11,283	1,195,998	47,636	6,954,856

Tenor of lead and zinc ore and concentrates produced in Kansas, 1919 and 1920.

	1919	1920
Total crude ore.....short tons..	1,391,600	1,704,700
Total concentrates in crude ore:		
Lead.....per cent..	1.01	1.22
Zinc.....do....	6.32	6.63
Metal content of crude ore:		
Lead.....do....	.80	.98
Zinc.....do....	3.80	3.98
Average lead content of galena concentrates.....do....	80.0	80.6
Average zinc content of sphalerite concentrates.....do....	60.1	60.0
Average value per ton:		
Galena concentrates	$68.27	$96.27
Sphalerite concentrates	$44.35	$45.36

The lead and zinc deposits of Kansas, so far as developed, are limited to Cherokee County, in the southeastern part of the State. They form the western extension of the ore deposits of the Joplin region and display the general characteristics shown in that region, except that here typical sheet ground deposits have not been extensively developed.

It is difficult to ascertain the production for early years or to segregate the Kansas ores from those produced in the Missouri portion of the Joplin region. If to the figures for the years 1886 to 1903 published by the Kansas Geological Survey[5] are added those for the years 1904 to 1920 published by the United States Geological Survey, a total output of 1,341,330 tons of zinc concentrates and of 197,306 tons of lead concentrates is shown as the approximate production of Kansas for 1886 to 1920.

The older mining camps at Lawton and Badger produced a little more zinc and lead in 1920 than in 1919, but the great increase in production from Kansas came from the Blue Mound-Baxter district, an extension of the Miami field; the few mines at Pershing, west of Badger; and the new Waco camp, on the Kansas-Missouri State line.

The increase in percentage of lead concentrates in crude ore milled in 1920 was due to the larger recoveries of lead from the new mines near Blue Mound, whose mills treated about 82 per cent of all the

[5] Haworth, Erasmus, and others, History, geography, geology, and metallurgy of Galena-Joplin lead and zinc: Kansas Univ. Geol. Survey, Vol. 8, 1904.

crude ore mined in Kansas in 1920, and to the lead ore mined at the upper levels of the new mines at Pershing.

The increase in zinc content of the sphalerite concentrates shipped was due to the much richer ore mined in the new Waco and Blue Mound districts and to lower ore prices and higher costs of mining.

Badger-Peacock district.—The production of the Badger-Peacock district, including several shipments of galena from the Kanok and Pershing mines at Pershing, west of Badger, was 723 tons of galena and 1,884 tons of sphalerite, against 139 tons of galena and 980 tons of sphalerite in 1919. The Hard Rock mine was the only large producer at Peacock, and the Kanok, which has a 400-ton mill, at Pershing.

Lawton-Waco district.—Nearly all the output of the Lawton-Waco district in 1920 was from the mines in Kansas, near Waco, as the one producing property at Lawton—the Eastern Lead & Zinc Co.—was operated only for a few days early in 1920. The total production of the district (including only mines in Kansas) was 15,777 tons of sphalerite, as compared with 32 tons of galena and 9,000 tons of sphalerite in 1919. The total output of the Waco district, lying partly in Missouri and partly in Kansas, in 1920 was 290 tons of galena and 36,857 tons of sphalerite, against 210 tons of galena and 25,136 tons of sphalerite in 1919. The principal producing properties in the Kansas part of the Waco district in 1920 were the Butte Kansas No. 2, which was operated part of the year by H. Neff; the Liberal mine, owned by the Freehold Oil & Gas Co.; the Butte Kansas No. 1; and the Barnsdall Zinc Mining Co. No. 3 mine, which was the largest producer. The 400-ton mill at Butte Kansas No. 2 was relocated and rebuilt in 1920, and 7,000 feet of drilling was done.

Galena district.—The production of lead concentrates in the Galena district in 1920 was 277 tons, as compared with 331 tons, in 1919; the shipments of sphalerite concentrates amounted to 922 tons, a decrease of 584 tons; and the metal content of the lead concentrates was 201 tons, against 249 tons in 1919. The average zinc content of sphalerite sold in the district, according to the reports of the operators, was 55.9 per cent. Little mining was done in the district, and most of the concentrates shipped had been mined in previous years or were recovered from clean-ups. In addition to the concentrates credited as shipped from Galena in 1920, the Magnetic Separating Co. treated more than 4,000 tons of green concentrates having a high content of iron, most of which were produced in Ottawa County, Okla., and shipped to Galena for treatment.

Blue Mound-Baxter Springs district.—Notwithstanding adverse conditions, especially during the last part of the year, there was considerable activity in that part of Cherokee County south and west of Baxter Springs, and north of the Oklahoma State line. Considerable drilling was done to locate bodies of ore, numerous shafts were sunk, several mills were erected, and pumps were installed to reduce the volume of water found at lower levels.

Most of the output in 1920, as in 1919, came from mines north and northwest of the Picher area and close to the State line, although mines north of Hockerville and east and north of Blue Mound produced a much larger output in 1920 than in 1919.

The shipments of concentrates, which amounted to 13,522 tons of galena and 76,470 tons of sphalerite in 1919, increased to 19,831 tons

of galena and 94,565 tons of sphalerite in 1920. The total value of lead and zinc concentrates sold in 1920 was $6,199,073. The average lead content of the galena sold was more than 80 per cent, and the zinc content of the sphalerite concentrates sold was 59.8 per cent. The crude ore ("dirt") milled yielded 8.2 per cent in concentrates, and at some mines the recovery was more than 16 per cent. Of this production in 1920 74.8 per cent was shipped by mines west and northwest of Blue Mound, whereas 86 per cent was shipped by these mines in 1919.

The largest producing properties in the area west and northwest of Blue Mound were the Blue Mound, Blue Diamond, Vinegar Hill (Barr), Webber, Southern, Early Bird, Big Elk, Lawyers, Federal (O. K.), Lucky Jim, Boska (old Redskin), Silver Fox, and Muncie. The producing properties north of Hockerville and Zincville and east and north of Blue Mound were the Hartley mine of the Chanute Spelter Co., Kansas Line, Monarch, Commonwealth No. 2, Naylor, Euterpe, Empire, and Queen Esther. The Mineral Float plant, which operated on tailings at the Blue Mound, was destroyed by fire in June, 1920, and was not rebuilt.

New concentrating plants were erected in 1920 by the Empire Development Co. (200 tons), Euterpe Mining Co. (250 tons), Iowa Mining Co. (200 tons), Commonwealth Mining Co. (No. 2, 250 tons), Kansas Line Mining Co. (200 tons), and Monarch Mining Co. (300 tons). The Hartley 500-ton mill of the Chanute Spelter Co. was erected in 1919, but milling operations were not begun until April, 1920, owing to the large volume of water encountered in the workings. More than 17,000 feet of drilling was done, two shafts were sunk, and ore was mined at the 227-foot level which yielded remarkable recoveries of sphalerite. In the first 12 months' operations 115,700 tons of ore was milled, which yielded 19,326 tons of sphalerite and 728 tons of galena. This recovery of 17.3 per cent was obtained from the cutting of ore from about 1 acre of ground. Several new shafts were being sunk late in 1920 on leases north and northwest of the Hartley mine, and a mill is being built on the Brewster land, where development has shown extensive ore deposits.

KENTUCKY.

By J. P. Dunlop.

Lead and zinc deposits are found in both central and western Kentucky. None of the mines in the central districts reported any lead or zinc concentrates shipped in 1920. The deposits in the fluorspar region of western Kentucky are chiefly in Crittenden, Caldwell, and Livingston counties and form a continuation of those in the southern Illinois lead and zinc region. The earliest available records of the occurrence of fluorspar and the associated galena in the Kentucky-Illinois region appeared in the first three volumes of the American Journal of Science, published in 1818, 1820, and 1821.[6] The first lead smelter using galena from Kentucky was erected by the River Valley Mining Co. at the Royal mine [7] about 1870.

[6] Ulrich, E. O., and Smith, W. S. T., The lead, zinc, and fluorspar deposits of western Kentucky: U. S. Geol. Survey Prof. Paper 36, pp. 16–17, 1905.
[7] Fohs, F. J., Fluorspar deposits of Kentucky: Kentucky Geol. Survey Bull. 9, 1907.

Considerable quantities of galena ores have been produced in former years, but at present lead is obtained solely as a by-product in the recovery and concentration of fluorspar, which is the principal economic mineral. The galena recovered is argentiferous, the silver content varying from a very small quantity to more than 3 ounces a ton, but no recovery of this silver content has been reported by the smelters during the last nine years.

Mine production of lead and zinc in Kentucky, 1907–1920.

Year.	Ores.						Metal content.			
	Lead concentrates (galena).		Zinc concentrates.				Lead.		Zinc.	
			Sphalerite.		Zinc carbonate.					
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1907–1915..	709	$31,602	723	$31,717	4,909	$160,669	480	$44,390	2,040	$342,886
1916.....	227	16,868	125	6,407	2,923	126,875	153	21,114	1,096	293,728
1917.....	184	15,415	.....	.....	2,299	78,368	123	21,156	751	153,204
1918.....	255	21,066	.....	.....	927	30,390	185	26,270	315	57,330
1919.....	120	7,250	.....	.....	120	3,600	86	9,116	36	5,256
1920.....	172	12,295	.....	.....	25	750	122	19,520	9	1,458

The average lead content of galena concentrates in 1920 was 71 per cent, against 72 per cent in 1919. The total value of the lead and zinc concentrates shipped from Kentucky mines was $13,045, against $10,850 in 1919.

The principal seller of galena concentrates was the Kentucky Fluorspar Co. The American Spar Co. operated the Hudson mine of the Eagle Fluorspar Co., near Salem, in Livingston County, part of the year, but did not ship any zinc carbonate. The ore was taken from workings about 85 feet in depth and treated in log washers before shipment. Most of the zinc carbonate shipped was sold by C. W. Haynes, of Marion, Ky.

MICHIGAN.

By F. Begeman.

PRODUCTION.

In 1920 the mines of Michigan produced 154,695,073 pounds of copper and 470,189 fine ounces of silver. The smelter production (output of refined copper) was 153,483,952 pounds, as compared with 177,594,135 pounds in 1919. The difference between the mine and the smelter production is due to the fact that the quantity of concentrates or "mineral" produced is not the same as the quantity smelted. A company may produce either more or less "mineral" than it smelts during the year.

Production was seriously hampered throughout the year by the extremely high cost of labor and supplies and by the lack of demand for copper and great decline in the price.

Value of silver and copper produced at Michigan mines in 1919 and 1920.

Year.	Silver.	Copper.		Combined silver and copper.
		Total.	Per ton of ore or "rock."	
1919	$494,402	$33,261,726	$4.33	$33,756,128
1920	512,506	28,463,893	4.79	28,976,399
Increase or decrease, 1920	+18,104	−4,797,833	+.46	−4,779,729

All the copper and silver produced in Michigan comes from the Keweenaw district. The ore ("rock") [8] is of low grade and requires milling, which produces concentrate ("mineral") carrying an average of about 65 per cent of copper. A small quantity of "barrel" and "mass" copper is sorted at the mines and sent direct to the smelters.

Mine production of silver and copper in Michigan in 1919 and 1920, by counties.[a]

County.	Silver (fine ounces).	Copper.			Concentrate ("mineral").		Ore ("rock") (short tons).
		Quantity (pounds).	Yield.		Quantity (pounds).	Yield (percentage).	
			Pounds per ton of ore ("rock").	Percentage.			
1919.							
Houghton	393,642	[b] 138,110,856	22.3	1.11	[c] 238,754,196	57.8	5,777,969
Keweenaw	17,552	33,830,487	21.8	1.09	48,535,790	69.7	1,552,916
Ontonagon	30,236	6,885,143	19.2	.96	12,182,050	56.5	359,368
Total or average	441,430	[b] 178,826,486	22.1	1.10	[c] 299,472,036	59.7	7,690,253
1920.							
Houghton	432,082	[b] 117,449,464	23.8	1.19	[c] 217,122,232	54.1	4,349,564
Keweenaw	.....	33,258,501	23.9	1.19	57,198,005	58.1	1,388,823
Ontonagon	38,107	3,987,108	19.9	.99	7,424,788	53.7	200,580
Total or average	[d] 470,189	[b] 154,695,073	23.7	1.18	[c] 281,745,025	54.9	5,938,967

[a] The figures are based on the actual recovery of copper from "mineral" smelted and the estimated recovery from "mineral" that was not smelted during the year.
[b] Includes copper from sands.
[c] Includes "mineral" from sands.
[d] Derived from the electrolytic treatment of 38,906,846 pounds of copper.

HOUGHTON COUNTY.

Houghton County occupies the central portion of the copper belt and contains 12 of the 18 mines that produced copper in 1920 and 6 of the 7 mines that produced silver.

Calumet & Hecla.—The Calumet & Hecla Mining Co. has been one of the most successful copper-mining companies in the world. To the end of 1920 it had distributed $152,250,000 in dividends.

[8] Some of the terms used to designate the different materials entering into the mining industry differ in the Lake district from those employed in any other part of the country. Ore is known as "rock" or (if unmined) "copper ground"; the product of concentration is known as "mineral"; and the term "ore" is used to designate the copper minerals (arsenides and sulphides) that occur to a minor extent in the district. Large bodies of native copper are known as "mass," and smaller bodies are called "barrel work." In this report the local terms will be used, as it does not seem desirable to employ the more usual terms to the exclusion of the local terms, and a mixture of the two is confusing.

The company's ground contains three copper-bearing lodes—the Calumet & Hecla conglomerate, the Osceola amygdaloid, and the "Kearsarge" amygdaloid. A large percentage of the production in the past has come from the conglomerate lode, but with the decrease in copper content of this lode and its approaching exhaustion the mining from the amygdaloid lodes has increased.

The company's annual report shows the details of operation for 1920 as follows: In all, 1,560,240 short tons of "rock" was treated, yielding 43,489,643 pounds of copper, or an average of 27.87 pounds of copper per ton of "rock," compared with a yield of 23.91 pounds for 1919. The total cost per pound of copper was 20.73 cents, including 5.39 cents for depreciation and depletion. The recovery of copper from old sands added to the recovery from "rock" made a total production of 57,627,883 pounds. The conglomerate lode produced 978,000 tons of "rock," which yielded an average of 35.10 pounds of copper per ton, compared with 29.61 pounds in 1919. The Osceola lode has an average width of 30 to 35 feet, though at some points it is much wider. The ore is confined principally to the wall. The lode is opened by drift stopes along the hanging wall, where the mineralization was rather uniform. Crosscuts are extended to the footwall, where the mineralization was far less regular. In 1920 this lode produced 582,240 tons of "rock," yielding 15.74 pounds of copper per ton, compared with 15.57 pounds in 1919. There was no output from the Kearsarge lode in 1920.

The reclamation plant for treating old tailings from Torch Lake treated 1,378,500 tons, having an average copper content of 13.10 pounds per ton. A total of 14,138,240 pounds of copper was recovered, or an average of 10.26 pounds per ton, at an average cost, exclusive of smelting and selling, of 6.60 cents per pound.

Summary of operations of regrinding plant, Calumet & Hecla Mining Co., 1920.

		From mine.	From old sands.
Ore treated	short tons	540,327	777,538
Assay of headings	per cent	0.626	0.771
Assay of tailings	do	0.428	0.479
Refined copper	pounds	2,221,000	4,692,200
Refined copper per ton treated	do	4.11	6.03
Cost per pound, exclusive of smelting and selling	cents	8.15	6.04

Summary of operations of leaching plant, Calumet & Hecla Mining Co., year 1920.

Ore treated	short tons	1,333,780
Assay of headings	per cent	0.517
Assay of tailings	do	0.115
Refined copper	pounds	10,880,940
Refined copper per ton treated	do	8.16
Cost per pound of copper, exclusive of smelting and selling	cents	5.26

Osceola.—In 1920 the Osceola Co. operated the three branches—the Osceola, South Kearsarge, and North Kearsarge. Dividends were declared to the amount of $96,150, and since 1878 this company has distributed dividends amounting to $17,756,375.

The Osceola branch lies directly south of the Calumet & Hecla and is worked on the Osceola amygdaloid. A total of 93,383 tons

of "rock" was produced in 1920, which yielded 1,671,263 pounds of copper, or an average of 17.90 pounds per ton.

The North Kearsarge lies north of the Wolverine and is worked on the Kearsarge lode. This branch produced 291,508 tons of "rock," yielding 4,483,129 pounds of copper, or an average of 15.38 pounds per ton.

The South Kearsarge lies south of the Wolverine and east of the Centennial on the Kearsarge lode. This branch produced 71,091 tons of "rock," yielding 1,311,381 pounds of copper, or an average of 18.45 pounds per ton.

In 1920 the company treated 455,982 tons of "rock," producing an average yield of 16.37 pounds of refined copper per ton, compared with 14.6 pounds in 1919. The total cost of refined copper per pound was 24.18 cents, including 4.65 cents for depreciation and depletion.

Centennial.—The Centennial ground lies north of the Calumet & Hecla and west of the South Kearsarge and the Wolverine. It contains parts of the Calumet & Hecla, Osceola, and Kearsarge lodes. The Kearsarge is the only one of proved value in the property, and to this lode operations are at present confined. "Rock" to the amount of 41,418 tons was stamped during 1920 and produced 13.55 pounds of refined copper per ton. The average cost of refined copper per pound was 36.17 cents, which includes 2.31 cents for depreciation and depletion.

Wolverine.—The Wolverine is between the North Kearsarge and South Kearsarge branches of the Osceola Co. Its operations are on the "Kearsarge" amygdaloid, though the West lode, parallel with the Kearsarge lode and about 80 feet to the west, has been opened to a small extent. The mine has the richest rock mined in the district. The operations on the Osceola lode have thus far proved disappointing. The Kearsarge lode in the Wolverine ground shows great uniformity of mineralization and is opened for the full length. In the upper levels the "rock" averaged from 16 to 18 pounds to the ton, but as the lower levels were opened it showed marked improvement. As the bottom limits are approached there is a notable decrease in the copper content of the rock.

During the fiscal year ending June 30, 1921, the company stamped 263,053 tons of "rock," which produced 6,290,075 pounds of "mineral," yielding 3,640,303 pounds of copper, or 13.838 pounds of refined copper to the ton. The total cost per pound of refined copper was 25.006 cents, including 5.403 cents for depreciation and depletion. Since its organization to June 30, 1921, the company has produced 173,171,831 pounds of copper.

Franklin.—The Franklin and the Rhode Island, which is controlled by the Franklin, are southeast of the La Salle. No copper was produced by the Franklin Mining Co. during 1920.

Quincy.—The Quincy mine is just north of the east arm of Portage Lake. The property is traversed by most of the lodes of the district, but it has derived its principal output in the past from the Pewabic lode, with a small quantity from the West lode. Dividends to the amount of $110,000 were paid in 1920. Total disbursements in dividends from 1862 to 1920 amounted to $27,002,500. In 1920 there was mined 809,263 tons of "rock," which yielded 34,167,620 pounds of "mineral" and 19,216,070 pounds of copper, an average of 23.75 pounds per ton.

Isle Royale.—The Isle Royale mine is south of the east arm of Portage Lake, near Houghton. The property contains several copper-bearing lodes, of which the Isle Royale is the main producer at present. During 1920 "rock" amounting to 591,971 tons was treated, yielding an average of 17.94 pounds of copper per ton. The average cost per pound of copper was 20.10 cents, including 3.29 cents for depreciation and depletion.

Baltic, Champion, and Trimountain.—The Baltic, Champion, and Trimountain mines are on the Baltic lode southwest of Houghton and are under the management of the Copper Range Co. The Baltic is an exceptionally strong lode, having a stoping width ranging from 15 to 80 feet. The lode has produced considerable "mass" copper and also contains veinlets of copper minerals, including chalcocite, bornite, and copper arsenides. These minerals are recovered in the mill, and the arsenides probably account in part for the arsenical character of the Copper Range output. During 1920 a total of 175,357 tons of "rock" from the Baltic mine was stamped, producing 37.71 pounds of refined copper per ton. The cost per pound of refined copper was 18.02 cents. A total of 116,768 tons of "rock" from the Trimountain was stamped, yielding an average of 30.24 pounds per ton, at an average cost per pound of 24.12 cents. Since its organization the company has disbursed $3,250,000 in dividends.

The Champion Copper Co. is controlled jointly by the Copper Range Co. and the St. Mary's Mineral Land Co. A total of 321,664 tons of "rock" was stamped, which produced 42.419 pounds of copper per ton, at a cost of 14.40 cents per pound. Since its organization the company has disbursed $25,850,260 in dividends.

Superior.—During the year 9,549 tons of "rock" from the Superior was stamped, producing 33.81 pounds of copper per ton, at a cost of 44.65 cents per pound, including 3.87 cents for depreciation.

La Salle.—The La Salle Co. produced 3,430 tons of "rock," yielding an average of 17.41 pounds of copper per ton, at a net cost of $1.30 per pound, including 10 cents for depreciation.

Winona.—Because of falling prices and high cost of copper, the mine and mill of the Winona Copper Co. were closed in May, 1920.

KEWEENAW COUNTY.

Keweenaw County occupies the northern portion of the copper belt.

Ahmeek.—The Ahmeek mine, north and east of the Allouez, is on the Kearsarge lode. A total of 822,192 tons of "rock" was stamped and yielded 24.9 pounds of refined copper per ton, at a total cost per pound of 16.08 cents, including 4.45 cents for depreciation and depletion. During the year dividends were declared to the amount of $300,000. Total dividends to the end of 1920 amounted to $12,150,000.

Allouez.—The Allouez mine is north of the North Kearsarge. In 1920, as in recent years, operations were confined to the Kearsarge lode. As this lode does not crop out on the Allouez property, the shafts were started in the hanging wall at a steep angle and flattened to the dip of the copper-bearing bed just before reaching it. This plan avoids the expense of long crosscuts necessitated by vertical shafts. A total of 131,643 tons of "rock" was stamped during 1920, and yielded an average of 18.98 pounds of refined copper per ton, at

a total cost per pound of 23.90 cents, including 3.54 cents for depletion and depreciation. Total dividends to April, 1919, amounted to $2,850,000.

Mohawk.—The Mohawk mine, east of the Ahmeek, carries the outcrop of the Kearsarge lode for more than a mile and also contains several cross fissures carrying arsenides of copper, which have been mined to a considerable extent. A total of 434,988 tons of "rock" was stamped and yielded 15,288,153 pounds of "mineral" and 10,269,824 pounds of copper, or an average of 23.61 pounds per ton, at a total cost per pound of 17.545 cents. Dividends amounting to $550,000 were paid in 1920.

ONTONAGON COUNTY.

Ontonagon County contains the southwestern portion of the copper belt, which has not been so thoroughly developed as the other portions and whose geology is consequently less understood than that of the more northern counties. So far as developed, the lodes are more "bunchy" than to the north and have produced a relatively high percentage of mass copper. The output in 1920 was derived wholly from amygdaloid rock.

The Mass mine, which adjoins the Adventure on the southwest, carries six known copper-bearing amygdaloid lodes—the Knowlton, Mass, North Butler, Butler, Ogima, and Evergreen. In addition, the position of the property makes it probable that the newly discovered lodes in this part of the district may be present in Mass ground. Early in 1920 the company closed its mines.

The Victoria is the most southwesterly of the Lake mines that have made large production. "Rock" amounting to 61,031 tons was stamped and yielded 1,569,676 pounds of "mineral" and 1,060,829 pounds of copper.

The White Pine Copper Co. treated 93,260 tons of "rock," yielding 1,850,787 pounds of copper, at a cost per pound of 28.91 cents, including 6.79 cents for depreciation and depletion.

The Michigan Copper Co. produced 46,289 tons of "rock," which with "mass" and "barrel" copper yielded 1,075,492 pounds of copper.

No active mining operations were carried on at the property of the South Lake Mining Co.

MISSOURI.

By J. P. Dunlop.

PRODUCTION.

The value of the mine production of recoverable silver, copper, lead, and zinc in Missouri in 1920 was $30,788,135, compared with $22,315,628 in 1919. The value of copper decreased $22,492, that of lead increased $9,109,500, that of silver increased $19,881, and that of zinc decreased $634,382. The recoverable lead content of Missouri lead concentrates sold in 1920 was equal to 34.6 per cent of the smelter production of primary lead in the United States derived from domestic ores, and the recoverable zinc content from Missouri zinc concentrates sold in 1920 was 5.4 per cent of the primary zinc produced by smelters from domestic ores in 1920, as against 22.7 per cent in 1917.

SILVER AND COPPER.

Mine production of silver and copper in Missouri, 1910–1920.

Year.	Copper.		Silver.		Lead concentrates, silver bearing (short tons).
	Quantity (pounds).	Value.	Quantity (fine ounces).	Value.	
1910–1918	3,527,293	$667,666	510,920	$333,582	495,823
1919	1,617,200	300,799	[a] 90,401	101,249	81,000
1920	1,512,539	278,307	[b] 111,128	121,130	90,000

[a] Includes 29,480 ounces of silver from cobalt-nickel-copper ore.
[b] Includes 28,664 ounces of silver from cobalt-nickel-copper ore.

The quantities given in the third column of the foregoing table are those of recovered silver. The silver content of the lead ores is so small that it is disregarded in the assay and sale of the concentrates. For this reason the smelter reports must be relied on for the silver production. As may be seen by inspection of the table, the quantity of silver produced in any year bears no direct ratio to the quantity of lead concentrates smelted during that year. The reason for this is that the silver content is so small in quantity that the silver bullion is stored and refined in batches. In a series of years, the concentrates average less than 1 ounce of silver to the ton.

The North American mine, now owned by the Missouri Cobalt Co., produced most of the copper in 1920. The remainder of the copper was derived from concentrates recovered in dressing lead ore mined in St. Francois County, in southeastern Missouri, and about 28,664 ounces of the silver reported from Missouri in 1920 was derived from copper concentrates and copper-nickel-cobalt ores.

LEAD AND ZINC.

The value of the recoverable metallic content of the lead and zinc concentrates produced in Missouri in 1920 was $30,388,698, an increase of $8,475,118 over that of 1919. The production of lead concentrates in Missouri in 1920 (of which all but 20 tons was galena) was 247,205 short tons, as compared with 237,428 tons in 1919. Of the output in 1920, 242,248 tons was derived from southeastern and central Missouri, an increase of 12,561 tons. The average metal content of the lead concentrates from these districts was 66.6 per cent, as compared with 68.4 per cent in 1919, and the value per ton in 1920 was $81.72. The quantity of recoverable lead in southeastern and central Missouri concentrates in 1920 amounted to 161,258 tons, an increase of 4,100 tons. The output was equal to about 34 per cent of the primary lead smelted or refined from domestic ores in the United States in 1920.

Shipments of galena concentrates from southwestern Missouri were 4,937 tons, compared with 7,724 tons in 1919. The lead carbonate concentrates amounted to 20 tons, an increase of 3 tons. The quantity of recoverable lead from southwestern Missouri, or the Joplin region, was 3,856 tons, a decrease of 2,276 tons. The average metal content of the galena concentrates from southwestern Missouri was 77.7 per cent and the average price per ton was $97.84, or $31.02 more than in 1919.

The quantity of zinc blende concentrates sold from Missouri mines in 1920 was 39,431 tons, a decrease of 12,382 tons compared with 1919. All the blende concentrate was produced in southwestern Missouri. The average price received per ton was $45.79, and the average recoverable zinc content reported by the sellers was 59.5 per cent. The average price received per ton in 1919 was $40.92 and the average recoverable zinc content was 58.5 per cent.

The zinc carbonate and silicate concentrates sold in 1920 amounted to 9,494 tons, or 2,247 tons less than in 1919. The output in 1920 was mainly from southwestern Missouri, the shipments from southeastern and central Missouri being only 61 tons, compared with 231 tons in 1919. The average metal content of the zinc carbonate and silicate concentrates was 39.8 per cent. The average price per ton in 1920 was $35.50, compared with $27.33 in 1919.

The combined value of lead and zinc concentrates from southeastern and central Missouri in 1920 (which produced about 98 per cent of the lead concentrates) was $19,801,299, or $8,203,746 more than in 1919. The total value of the southwestern Missouri lead and zinc concentrates was $2,626,186, as compared with $2,939,413 in 1919.

The total quantity of crude ore or "dirt" mined and treated in 1920 was 6,108,030 short tons. As the total amount received for all classes of lead and zinc concentrates sold in 1920 was $22,427,485, the average value per ton of crude ore or "dirt" mined and treated was $3.67, the highest average in nine years.

In the following tables showing the tenor of crude ore ("dirt") and concentrates from Missouri it has been considered advisable to segregate the ores of different nature. The disseminated lead ore of southeastern Missouri differs radically from the lead and zinc ores of the so-called "soft ground" deposits of southwestern Missouri. Each class of ore has its peculiar problems of mining and ore dressing. The data are given for the ores mined in the Joplin region, but as the recoveries from "sheet ground" were very small in 1920 it was not possible to differentiate between the "soft ground" and "sheet ground" recoveries. In general, the tables reflect very closely the conditions of the industry.

Mine production of lead and zinc in Missouri in 1920, by districts.

District	Lead concentrates.			
	Galena.		Carbonate.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Southwestern Missouri:				
Ash Grove-Everton	5	$450	.....	.....
Aurora	11	1,003	.....	.....
Cave Springs-Belleville	58	5,309	.....	.....
Duenweg-Porto Rico	163	16,342	.....	.....
Granby-Diamond	258	20,134	.....	.....
Joplin	337	31,394	.....	.....
Oronogo	1,700	164,344	.....	.....
Spring City-Beef Branch-Spurgeon	32	3,358	20	$1,034
Waco (Mo.)	230	23,813	.....	.....
Webb City-Carterville-Prosperity	2,083	218,351	.....	.....
	4,937	484,498	20	1,034
Central and southeastern Missouri	242,248	19,799,389	.....	.....
	247,185	20,283,887	20	1,034
Total, 1919	237,411	12,107,125	17	606

Mine production of lead and zinc in Missouri in 1920, by districts—Continued.

District.	Zinc concentrates.			
	Sphalerite.		Silicate and carbonate.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Southwestern Missouri:				
Ash Grove-Everton			75	$1,875
Aurora	25	$1,000	231	8,398
Carthage	227	12,923		
Cave Springs-Belleville	1,421	58,567		
Duenweg-Porto Rico	680	29,515	1,561	51,672
Granby-Diamond	872	33,110	6,769	250,202
Joplin	2,530	114,716	466	14,572
Oronogo	7,870	327,534		
Spring City-Beef Branch-Spurgeon	5	186	25	972
Springfield	239	14,000	36	1,330
Waco (Mo.)	21,080	1,031,747		
Webb City-Carterville-Prosperity	3,714	148,066		
Wentworth-Pierce City	768	34,197	184	3,292
Howell, Ozark, and Wright counties			86	2,780
	39,431	1,805,561	9,433	335,093
Central and southeastern Missouri			61	1,910
	39,431	1,805,561	9,494	337,003
Total, 1919	51,813	2,108,382	11,741	320,853

District.	Metal content.[a]			
	Lead.		Zinc.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Southwestern Missouri:				
Ash Grove-Everton	4	$640	21	$3,402
Aurora	8	1,280	95	15,390
Carthage			129	20,898
Cave Springs-Belleville	43	6,880	756	122,472
Duenweg-Porto Rico	129	20,640	879	142,398
Granby-Diamond	181	28,960	2,879	466,398
Joplin	266	42,560	1,503	243,486
Oronogo	1,308	209,280	3,956	640,872
Spring City-Beef Branch-Spurgeon	36	5,760	11	1,782
Springfield			147	23,814
Waco (Mo.)	223	35,680	11,748	1,903,176
Webb City-Carterville-Prosperity	1,658	265,280	1,857	300,834
Wentworth-Pierce City			480	77,760
Howell, Ozark, and Wright counties			29	4,698
	3,856	616,960	24,490	3,967,380
Central and southeastern Missouri	161,258	25,801,280	19	3,078
	165,114	26,418,240	24,509	3,970,458
Total, 1919	163,290	17,308,740	31,540	4,604,840

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses in zinc but not in lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average sales price for all grades.

Tenor of crude lead and zinc ore and concentrates produced in southwestern Missouri in 1918, 1919, and 1920.

	1918	1919	1920 [a]
SOFT GROUND.[b]			
Total crude ore.....short tons..	1,710,900	1,114,300	1,304,400
Total concentrates in crude ore:			
Lead.....per cent..	0.41	0.48	0.40
Zinc.....do....	4.30	5.24	3.75
Metal content of crude ore:			
Lead.....do....	.32	.38	.31
Zinc.....do....	2.30	2.90	2.09
Average lead content of galena concentrates.....do....	77.4	77.8	77.7
Average lead content of lead carbonate concentrates.....do....	55.5	53.0	55.0
Average zinc content of sphalerite concentrates.....do....	58.6	58.9	59.5
Average zinc content of silicates and carbonates.....do....	37.1	40.3	39.8
Average value per ton:			
Galena concentrates	$87.35	$65.06	$97.84
Lead carbonate concentrates	$65.88	$35.65	$51.70
Sphalerite concentrates	$52.71	$41.33	$45.79
Zinc silicates and carbonates	$32.23	$27.33	$35.50
SHEET GROUND.			
Total crude ore.....short tons..	1,903,300	274,500	(c)
Total concentrates in crude ore:			
Lead.....per cent..	0.51	1.01	.....
Zinc.....do....	2.10	1.82	.....
Metal content of crude ore:			
Lead.....do....	.41	.82	.....
Zinc.....do....	1.21	1.05	.....
Average lead content of galena concentrates.....do....	77.4	81.1	.....
Average zinc content of sphalerite concentrates.....do....	57.7	54.9	.....
Average value per ton:			
Galena concentrates	$91.32	$70.30	.....
Sphalerite concentrates	$49.25	$35.03	.....

[a] Includes all ore mined and milled, 1920.
[b] Including also the small production of lead and zinc ores in southeastern and central Missouri not included in the "disseminated lead" district.
[c] Quantity of ore from "sheet ground" very small; it is included with ore from "soft ground" in 1920. Part of the concentrates shipped in 1920 was from ore milled in 1919.

Tenor of crude lead ore and concentrates in southeastern Missouri disseminated lead ore in 1918, 1919, and 1920.

	1918	1919	1920
Total crude lead ore.....short tons..	5,532,600	4,301,930	4,803,630
Galena concentrates in crude ore.....per cent..	5.01	5.32	5.04
Lead content of crude ore.....do....	3.39	3.65	3.35
Average lead content of galena concentrates.....do....	66.8	68.4	66.6
Average value per ton of galena concentrates	$75.53	$50.46	$81.72

In Mineral Resources for 1914, Part I, pages 72–77 and 97–100, was given a brief history of lead and zinc mining in the southeastern Missouri and Joplin regions, together with data relating to the total lead and zinc production, the mining and milling practice, the character of the ore and concentrates, and the methods of selling them.

In order to expedite the publication and distribution of this report many of the data relating to individual properties as given in previous reports under the reviews by districts have been omitted. All the essential data relating to the districts are included in the yearly State review of the regions.

SOUTHWESTERN MISSOURI.

AREA AND PRODUCTION.

The southwestern Missouri lead and zinc areas include the largest part of the Joplin region, the remainder lying in southeastern Kansas and northeastern Oklahoma.

Lead and zinc concentrates produced in the Missouri part of the Joplin region, 1907–1920.

	Quantity (short tons).	Value.	Average price per ton.
Lead concentrates	436,731	$27,673,241	$63.36
Sphalerite concentrates	2,696,122	138,840,758	51.50
Zinc carbonate and silicate concentrates	288,213	8,973,990	31.14
	3,421,066	175,487,989	.....

ASSAYS.

Several of the assayers in the Joplin district have made a practice of saving the remnants of blende samples analyzed during the year. At the end of the year the lot is thoroughly mixed and carefully sampled, and from the sample an average or composite assay for the year is made. Each assay thus represents several thousand lots. One series giving the result of analyses of composite samples from the general district for 1897–1918 was given in Mineral Resources for 1919, Part I, page 267. No separate composite samples of concentrates from Missouri mines were made in 1919 or 1920.

Another series of composite assays, on samples that represented mainly ores from the different camps of the district, for 1900–1918, was given on page 268 of the volume cited. The methods used in making these assays have been published.[9]

PRICES.

The following quoted base prices apply not only to southwestern Missouri but also to all the mines in Oklahoma and Kansas that are in the Joplin region. The average quoted base prices for 60 per cent sphalerite were highest during January, 1920. The base prices quoted were from $55 to $57 a ton in the first week in January, $61 in the second and third weeks and $52.50 the last week. The March prices showed a drop to $47.50, and the April prices to $42.50. Prices were fairly steady then until the end of June, when they increased to $45. July and August prices were between $46 and $47.50. At the end of September prices declined to $42.50, and in October to $40. Then there was a sensational decline in November to $30, and this price, except for a slight increase for two weeks, prevailed until the end of 1920 and caused most of the mines to close because concentrates could not be profitably produced at so low a price.

[9] Waring, W. G., The volumetric determination of zinc: Am. Chem. Soc. Jour., vol. 26, No. 1, January, 1904. In addition to the composite assays for 1902 and 1903, shown in the table, this article gives the lead, copper, and cadmium content of a number of ores from individual mines in Missouri, Kentucky, and Illinois.

Base prices for calamine or zinc silicate ores were better sustained than those of sphalerite, for while the variation in sphalerite was more than $31 a ton that in calamine was only $15 a ton, and at certain periods during the year calamine containing 40 per cent of zinc sold at about the same price as sphalerite containing 60 per cent of zinc, owing to the scarcity of calamine ores in the Central States and an active demand for concentrates of that class. The average yearly price of zinc silicate was $8.17 a ton more in 1920 than in 1919, whereas the average price for sphalerite increased only $4.46 a ton. The lowest base prices for calamine were quoted in December and the highest in February and March, when they ranged from $38 to $40 a ton.

The quoted price for galena carrying 80 per cent of lead showed wide variations, opening in January at $90 to $95 a ton and closing in December at $47.50 a ton. During the year galena sold for as much as $112 a ton in August and for as little as $47 at the end of December. The high prices did not stimulate the production of lead from southwestern Missouri, for there was a large decrease in production.

The average price per ton paid for sphalerite or blende in 1920 was $45.79, compared with $40.67 in 1919, $51.27 in 1918, $71.04 in 1917, $82.60 in 1916, and $76.25 in 1915; for zinc silicate or carbonate concentrates $35.50 in 1920, $27.30 in 1919, $32.27 in 1918, $40.50 in 1917, $50.21 in 1916, and $45 in 1915; for galena concentrates $97.84 in 1920, $66.82 in 1919, $89.92 in 1918, $101.90 in 1917, $84.29 in 1916, and $52.52 in 1915. These prices are not averages of base-price quotations, but are the averages calculated from the quantity sold and the amounts received as reported to the United States Geological Survey by the sellers.

GENERAL CONDITIONS.

Although prices for both lead and zinc concentrates were above normal in the early part of the year, there was again a large decrease in the total mine output from the Missouri part of the Joplin region. Very little prospecting was done except in the Webb City-Carterville-Prosperity area. Development and mining of "sheet ground" ceased entirely, and few properties were equipped with plants. Nearly all the large mills were torn down and removed, leaving only the huge piles of tailings to mark the former activities at most of the large camps. Part of the zinc concentrates shipped in 1920 were made in 1919. The Waco district (in Missouri only) produced more than half of the entire output of sphalerite shipped from southwestern Missouri in 1920. The mines at Waco which contributed the 21,080 tons of sphalerite and 290 tons of galena were those of the Barnsdall Zinc Mining Co. (No. 2), Freehold Oil & Gas Co. (Nos. 2 and 3), High Five Mining Co., Allegheny Western Mining Co., Tulsa Pittsburg Mining Co., Gilman Mining Co., and the Gascho Zinc Co. Though the output was large in 1920, the low price of sphalerite prevailing the last half of the year caused all the plants except the Barnsdall to close. No concentrates were sold from any mines in the Alba-Neck City, Carl Junction, Stark City, Thoms Station, or Sarcoxie-Reeds districts, and the production in the Aurora, Ash Grove,

Carthage, Springfield, Duenweg, and Spurgeon districts was scattered and small. The only property at Cave Springs which yielded a good production was that of the Imperial Zinc Co. There were more active mines at Granby than in any other district, and these small mines yielded 71 per cent of the Missouri production of zinc silicate and carbonate concentrates, and also 258 tons of galena, and 872 tons of sphalerite. The total value of the output at Granby placed that camp next after Waco and Oronogo, which held first and second place, respectively.

The two large mines at Oronogo, the Oronogo Circle and Oronogo Mutual, produced about the same quantity of galena and sphalerite in 1920 as in 1919. Both were closed late in 1920, and the large mill at the Oronogo Mutual is being dismantled. No large plants near Joplin were operated steadily in 1920, though a number of small operators shipped 337 tons of galena, 2,530 tons of sphalerite, and 466 tons of zinc silicate. Most of the output came from leases of the Missouri Lead & Zinc Co., Rex Mining & Smelting Co., St. Louis Joplin Mining Co., F. F. Creller, and Continental Zinc Co. The C. M. & H. Mining Co. produced considerable high-grade sphalerite for several months, and the Louisiana Mining Co., on the Rensenhauser land, also sold some very high-grade zinc concentrates. The production in the Wentworth-Pierce City district was slightly more in 1920 than in 1919, owing to the operations of Hines & Co., Rice & Co., and the Morning Star Mining Co. The Webb City-Carterville-Prosperity district had a small output compared with that of former years. The shipments in 1920 were 2,083 tons of galena and 3,714 tons of sphalerite. The largest producer of both lead and zinc was the Tom C. mine on the Connor land. Other properties which yielded good shipments were the American Zinc, Lead & Smelting Co. (No. 2) and the Miller Mining Co. (Concord mine). The remainder of the shipments from the district were of ores from scrapping and cleanups. At the end of 1920 not more than five or six companies were mining ore in southwestern Missouri, and the only large plant in operation was the Barnsdall, at Waco.

CENTRAL AND SOUTHEASTERN MISSOURI.

A brief description of the ore deposits in central and southeastern Missouri is given in the separate chapter entitled "Silver, copper, lead, and zinc in the Central States in 1915," which may be obtained upon application to the Director, United States Geological Survey, Washington, D. C.

Copper, nickel, and cobalt occur in the ore, in considerable quantity in the vicinity of Fredericktown, and in small quantity irregularly in nearly all deep mines. It is only near Fredericktown that the copper, nickel, and cobalt content of the ore has been the object of mining, yet a concentrate of these metals has been recovered as a table middling at several plants in other parts of the district, and 3,115 tons of copper concentrates were shipped in 1915, 2,878 tons in 1916, 2,304 tons in 1917, and a much larger quantity in 1918, 1919, and 1920, as the Missouri Cobalt Co. shipped more low-grade concentrates.

In the disseminated-ore district the production after 1869 increased rapidly and is estimated by Buckley to have amounted to 1,202,607

tons of lead concentrates, valued at $59,869,354, for the period between 1869 and 1906, inclusive. The mine production of southeastern and central Missouri has been reported to the United States Geological Survey since 1907.

Mine production of lead and zinc concentrates in southeastern and central Missouri, 1907–1920.

Year.	Lead concentrates (galena).		Zinc concentrates.			
			Sphalerite.		Carbonate and silicate.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1907–1915	1,945,996	$85,207,971	452	$13,108	8,435	$168,929
1916	307,025	20,720,737	365	14,400	1,030	42,129
1917	306,473	30,070,995	186	16,344	293	7,145
1918	271,506	20,507,064	13	285	235	6,845
1919	229,687	11,590,977	.....	.....	231	6,576
1920	242,248	19,799,389	.....	.....	61	1,910

The lead ore of southeastern Missouri carries a small proportion of silver, the average being less than 1 troy ounce to the ton of lead concentrates. The resulting pig lead likewise carries silver, together with a little copper, nickel, cobalt, and traces of antimony and arsenic, and is sometimes commercially known as "Missouri chemical" lead in contradistinction to "Missouri soft" lead from the Joplin region.

The output of silver in Missouri in 1920 was derived mainly from refining pig lead, the only other source of production being about 28,664 ounces recovered from cobalt-nickel-copper ores and from copper concentrates recovered in dressing lead ores, which were shipped to smelters.

The production of silver in 1920 was recovered from about 90,000 tons of lead concentrates and from copper concentrates that averaged slightly more than 1 ounce to the ton.

The crude lead ore mined in the disseminated-lead district in 1920, amounting to 4,803,630 short tons, yielded 5.04 per cent of lead concentrates, which averaged 66.6 per cent of lead. The average value per ton of the lead concentrates in 1920 was $81.72, as compared with $50.46 in 1919, and the concentrates were slightly lower in lead content than in 1919. The output of galena concentrates was 242,004 tons in 1920, against 228,983 tons in 1919. As several of the large producers not only mine but also smelt their lead concentrates, the values given for concentrates are to a certain extent arbitrary. The galena concentrates produced in the southwestern Missouri region, which contain a higher lead content, are sold mainly on bids from purchasers, and the prices for those lead concentrates are not comparable with prices given for concentrates of the disseminated-lead district.

Analyses of ores mined in disseminated lead district in southeastern Missouri and of the various grades of resulting concentrates.[a]

	Ag	Cu	Pb	SiO_2	Fe	Al_2O_3	CaO	MgO	Zn	S	Ni and Co
	Oz. per short ton.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Ore (crude)	0.12	0.06	5.7	5.0	4.1	4.9	25.5	14.2	0.8	2.0	.....
High-grade concentrates	.7	.13	73.2	1.0	3.5	.....	2.6	.8	.4	15.0	0.05
Medium-grade concentrates	1.3	.12	68.6	1.4	4.6	.....	3.1	1.4	.8	15.5	.05
Low-grade concentrates	1.0	.30	65.8	.5	3.1	.5	4.3	2.8	1.7	13.7	.....
Flotation slimes, concentrates	.....	.50	45.0	9.6	4.4	3.1	7.5	4.2	4.0	12.3	.....
Flotation slimes, high-grade concentrates	3.7	.05	57.8	6.0	2.7	.....	2.2	1.4	9.4	15.5	.....
Joplin (southwestern Missouri) concentrates	.....	.....	80.2	1.1	1.0	.....	.4	.....	1.7	13.3	.....

[a] Garlichs, Herman, Metallurgy of lead ores in the lower Mississippi Valley: Am. Inst. Min. Eng. Bull., July, 1917, pp. 1041–1046.

NOTE.—A typical analysis of southeastern Missouri undesilverized lead is as follows: Ag, 0.0080 (2.4 oz. net short ton); As, trace; Sb, 0.0030; Bi, trace; Cu, 0.0800; Fe, 0.0015; Zn, trace; Ni and Co, 0.0080; lead by difference, 99.8995.

The production of zinc carbonate from southeastern Missouri in 1920 amounted to 61 tons, against 231 tons in 1919. All the zinc carbonate was shipped from mines in Franklin, Oregon, and Jefferson counties.

The quantity of galena recovered from shallow diggings in Washington and Jefferson counties was only 244 tons. The ore, which occurs at shallow depths and in association with barytes, is mined in a small way and at odd times by the barytes miners. Much of this ore was purchased by J. F. Evans, of Potosi.

The Buckeye or North American mine, at Fredericktown, was operated by the Missouri Cobalt Co. The concentrating plant, which has a capacity of 300 tons, and the 100-ton smelter and refinery were actively operated in 1920. The lead concentrates produced were smelted at the Federal plant, and the copper concentrates containing nickel and cobalt were shipped to the Grasselli Chemical Co., Grasselli, Ind., for making sulphuric acid. The cinders from the copper concentrates are returned to the smelter and refinery of the Missouri Cobalt Co. for the recovery of the cobalt, nickel, and copper. A considerable quantity of copper, nickel, and cobalt was marketed in 1920.

Nearly all the lead produced in southeastern Missouri was mined by the National Lead Co., St. Joseph Lead Co., Desloge Consolidated Lead Co., and Federal Lead Co., the St. Joseph Lead Co. being the largest producer. There were no important changes in the equipment of any of the mining plants.

The option which the Eagle Picher Lead Co. had on the Schulte tract was dropped, and the drill rig was installed on property south of Elvins, which is owned in fee by the company. Some development work which yielded a considerable quantity of galena was done on Eagle Picher property near Morrellton, in Franklin County, which was purchased in 1920.

A small quantity of zinc silicate and carbonate was made by the Alton Zinc Mining & Trading Co., near Alton, in Oregon County, by means of log washing ore mined at shallow levels.

OKLAHOMA.

By J. P. Dunlop.

Mine production of lead and zinc in Oklahoma in 1920, by districts.

District.	Ores.					
	Lead concentrates (galena).		Zinc concentrates.			
			Sphalerite.		Carbonate and silicate.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Ottawa County:						
Miami	81,413	$7,647,400	405,868	$18,249,194	.....	.....
Quapaw	41	3,852	1,701	71,681	.....	.....
Peoria	10	800	.....	.....	14	$462
Total, 1919	81,464	7,652,052	407,569	18,320,875	14	462
	67,830	4,603,520	337,071	14,494,562	20	600

District.	Metal content.[a]			
	Lead.		Zinc.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Ottawa County:				
Miami	65,355	$10,456,800	218,823	$35,449,326
Quapaw	31	4,960	900	145,800
Peoria	8	1,280	4	648
Total, 1919	65,394	10,463,040	219,727	35,595,774
	53,872	5,710,432	178,410	26,047,860

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses of zinc but not of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price of all grades.

The following table gives the output of crude lead and zinc ore for the whole State of Oklahoma, but it was thought advisable to calculate the tenor of crude ore and concentrates as well as assay content and value of concentrates separately for the Miami and Quapaw districts, inasmuch as the character of the ground operated in these districts has, until the new mines in the easterly extension of the Miami district, near Quapaw, were opened in 1918, differed so radically that general calculations for the State would be valueless:

Tenor of lead and zinc ore and concentrates produced in Oklahoma, 1919 and 1920.

	1919	1920
Total crude ore milled in Oklahoma ..... short tons..	6,168,200	6,943,100
Miami district:		
Total concentrates in crude ore—		
Lead ..... per cent..	1.13	1.18
Zinc ..... do....	5.47	5.87
Metal content of crude ore—		
Lead ..... do....	.87	.92
Zinc ..... do....	3.21	3.52
Average lead content of galena concentrates ..... do....	79.4	80.2
Average zinc content of sphalerite concentrates ..... do....	58.8	59.9
Average value per ton—		
Galena concentrates	$67.87	$93.93
Sphalerite concentrates	$43.00	$44.96
Quapaw district:		
Total concentrates in crude ore—		
Lead ..... per cent..	.57	.13
Zinc ..... do....	3.15	5.49
Metal content of crude ore—		
Lead ..... do....	.43	.10
Zinc ..... do....	1.76	3.23
Average lead content of galena concentrates ..... do....	77.0	75.6
Average zinc content of sphalerite concentrates ..... do....	55.8	58.8
Average value per ton—		
Galena concentrates	$60.10	$93.95
Sphalerite concentrates	$44.30	$42.14

Mine production of lead and zinc concentrates in Oklahoma, 1891–1920, by districts.

District.	Lead concentrates (mainly galena).		Zinc concentrates.			
			Sphalerite.		Zinc silicate and carbonate.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Peoria	2,164	$105,958	220	$8,289	2,738	$73,432
Quapaw	4,137	267,196	35,788	1,544,826	164	2,692
Miami	308,819	25,155,631	1,377,415	67,358,832	.....	.....
Davis	.....	.....	558	27,399	899	24,592
	315,120	25,528,785	1,413,981	68,939,346	3,801	100,716

The chapter on the production of lead and zinc in Oklahoma in Mineral Resources for 1914 contains a brief history of mining in the various districts and also the estimated total production of each district, by years.

The total value of the lead and zinc concentrates shipped from Oklahoma in 1920 was more than ten times as much as the value in 1915.

The lead and zinc deposits of northeastern Oklahoma, so far as known, are confined to Ottawa County and form the southwestern extension of the deposits in the Joplin region. There are three camps, Peoria, Quapaw, and Miami, in which extensive mining has been done, and a fourth, the Sycamore Creek district, along the Seneca fault block from 2 to 3 miles southwest of Seneca, Mo., in which considerable prospecting has been done and some ore mined. The lead and zinc deposits in southern Oklahoma are near Ravia, at the southeast end of the Arbuckle Mountains, and near Davis, Murray County, at the northwest end of the same range.

The quantity of crude ore milled in Oklahoma increased 774,900 tons in 1920, notwithstanding the fact that the quantity of ore milled by the old mines near Commerce and at Quapaw increased very little. The value of the recoverable lead and zinc produced at mines in Oklahoma in 1920 was $46,058,814, compared with $31,758,292 in 1919. The metal content of lead concentrates increased from 53,872 to 65,394 tons, and the recoverable zinc from 178,410 to 219,727 tons.

In 1920 the lead concentrates produced in the Oklahoma districts were slightly higher in grade than those shipped in 1919. The average metal content of the sphalerite concentrates from Miami ore increased from 51.8 per cent in 1912 to 59.6 per cent in 1917 and 1918, decreased to 58.8 per cent in 1919, and increased to 59.9 per cent in 1920, although the average zinc content of the sphalerite recovered from ore and tailings at the old mines near Commerce was only 53.6 per cent in 1920.

The Miami district (in Oklahoma only) produced about 76 per cent of the total output of lead concentrates in the Joplin region, exceeding the Missouri portion of the region by about 76,500 tons. The Oklahoma shipments of sphalerite in 1920 amounted to 407,569 tons, an increase of 70,498 tons. The Miami district yielded about 99.6 per cent of the sphalerite concentrates and 99.9 per cent of the galena concentrates sold in Oklahoma in 1920.

Peoria district.—The production at Peoria, the oldest mining camp in Oklahoma, was only 10 tons of galena and 14 tons of zinc silicate, all of which was mined by small operators at shallow levels.

Davis district.—No shipments of lead or zinc in 1920 were reported by any mines in the Davis district, in Murray County.

Quapaw district.—The total production of concentrates in the Quapaw district was small in 1920, and none of the mills were in steady operation. The sales of galena decreased from 98 tons in 1919 to 41 tons in 1920, and those of sphalerite increased from 545 to 1,701 tons. The total value of the concentrates sold in 1920 was $75,533, an increase of $45,500. Part of the concentrates sold in 1920 were derived from ore mined in 1919. None of the older mines near Lincolnville produced any lead or zinc. All the output was made early in the year, and none of the mines near Quapaw were in operation at the end of the year. The largest producing property was the West Virginia, at Sunnyside. Shipments were also made from the Canton, Hope, Right Good, Cedar Bluff, and Long Hunt mines.

Miami district.—A history of the mining in the Miami district, including the output by years for the period 1908 to 1914, and of the location of the mines and mills, was given in Mineral Resources for 1914. The reports for the years 1915 to 1919 contain full reviews of the production, new territory prospected, new mines opened, and new mills erected in those years. A brief description of the ore deposits in the Miami district is given in the chapter on zinc in Mineral Resources for 1915.[10]

The mines of the Oklahoma part of the Miami district in 1920 shipped 81,413 short tons of galena concentrates and 405,868 short tons of sphalerite concentrates, an increase of 13,743 tons of galena concentrates and of 69,465 tons of sphalerite concentrates when compared with the output of 1919. The average price of the galena

[10] Siebenthal, C. E., Zinc: U. S. Geol. Survey Mineral Resources, 1915, pt. 1, pp. 888–890, 1917.

concentrates increased $26.06 a ton, and the average price of sphalerite concentrates, of which nearly five times as much was shipped, increased $1.96 a ton. This increase in the quantity of concentrates shipped, following increases of nearly 200 per cent in 1917, 92 per cent in 1918, and 10 per cent in 1919, does not adequately show the development during the last four years, for only a few of the milling plants were operated at capacity and many were idle part of 1920.

Many mines recovered large quantities of galena, which, when sphalerite prices decreased in May, made operation profitable, notwithstanding the much lower price of sphalerite. The operating costs at Miami are greater than in most of the other districts in the Joplin region, and the royalties paid averaged 50 per cent more. The increased recovery of concentrates in the Miami district and the larger quantity of galena recovered compensated for the higher operating costs, but it is certain that many of the Miami mines were not operated profitably. Mining costs decreased very little, especially such large items of expense as powder, steel, lumber, coal, and electric power. Some mines having rich ore were operated at a profit during the first part of 1920, but as prices declined they were shut down whenever it was possible to do so without forfeiting the lease.

In June the mines were closed for a week to cut the production and to relieve the shortage of cars. In September the price of lead began to decline, in October the mines were not operated for two weeks, and as conditions did not improve many of the properties remained idle the remainder of the year. Wages were cut 10 to 20 per cent in November and many mines were idle, though some companies operated without profit to take care of their employees. In December not more than 20 per cent of the mines were in operation and most of them were working single shift, with a curtailed number of miners. Some operators having rich ore bodies with only a limited period in which to remove ore preferred to operate on a very small margin rather than close. Labor was plentiful after August and its efficiency increased 25 per cent. All the mines are provided with adequate shipping facilities by rail and roadway. Few mining districts have better facilities for transportation of supplies and men.

The production in 1920 in the Miami district (in Oklahoma) was that of about 135 mills, of which 5 were in the old Commerce camp and the remainder in the territory north and northeast to the Kansas State line and east to Quapaw. In the northerly extension of the Miami field in Kansas about 26 mills were in operation at different times in 1920. Many of the mills were operated intermittently. It is estimated that in 1920 there were more than 200 concentrating plants—many of them of large capacity—in Ottawa County.

The quantity of crude ore mined and milled increased from approximately 6,149,300 tons in 1919 to 6,912,000 tons in 1920. The percentage of concentrates recovered from crude ore milled was larger than in any other district in the Joplin region, and with increased operations in the northern part of the district the ore treated showed an increase in percentage of concentrates recovered from 5.5 per cent in 1917 to 6.45 per cent in 1918, 6.6 per cent in 1919, and 7.05 per cent in 1920. The average metal content of the sphalerite was 51.8 per cent in 1912, 58.8 per cent in 1919, and 59.9 per cent in 1920, so that the total increase in the zinc content of the sphalerite sold has been 8 per cent in eight years.

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The separate assays reported showed the zinc content to range from 48 to 63 per cent, but most of the blende assayed between 58 and 60.5 per cent. An assay of a composite sample of ore shipped in 1920 from the Miami-Blue Mound region, made by Bruce Williams, of Joplin, Mo., showed an average content of 59.7 per cent of zinc, 1.4 per cent of iron, 0.87 per cent of lead, and 0.58 per cent of lime. This assay shows that the average zinc content as computed from the reports of all the companies selling concentrates differed only 0.2 per cent from the assay of the composite sample. The average price of galena concentrates increased from $67.87 in 1919 to $93.93 in 1920, and that of sphalerite concentrates from $43 to $44.96.

The recovery of concentrates from all the mines averaged about 1 ton of galena to 5 tons of sphalerite, which is a much higher average than in any other district in the Joplin region or in Wisconsin. The proportion of galena concentrates recovered from the "dirt" mined showed wide variations in different mines, ranging from less than 1 ton of galena to 100 tons of sphalerite to 1 ton of galena to 1 ton of sphalerite.

The mines in the new camps in the vicinity of Tar River, Picher, Douthat, St. Louis, and Hockerville treated about 6,841,000 tons of crude ore, which yielded 79,910 tons of galena concentrates and 402,795 tons of sphalerite, an average recovery of 1.17 per cent in galena concentrates and 5.89 per cent in sphalerite concentrates, or a total recovery of 7.06 per cent. As some of the large mines reported a recovery as high as 8 to 15 per cent, some of the mines must have treated ore that yielded only 3 to 4 per cent, or even less, in concentrates. It is difficult to segregate the producing mines according to camps.

The total shipments of those properties that may properly be classed as in the Tar River-Douthat area, of which there were a greater number than in the other areas, were 34,666 tons of galena and 167,891 tons of sphalerite. About 2,959,800 tons of "dirt" was milled, so that the recovery in concentrate averaged about 6.84 per cent. A few of the mines near Cardin yielded nearly as much galena as sphalerite; in a few mines near Century the proportion of galena was as little as 1 per cent; and the proportion of galena to sphalerite on the whole was less than that recovered from the mines near Picher. The proportion of galena to sphalerite recovered at all the mines in the vicinity of Douthat was about 1 ton of galena to 7.3 tons of sphalerite; in the Tar River section the mines yielded about 1 ton of galena to 4 tons of sphalerite.

The territory lying east of Picher, near the Hockerville and Zincville (St. Louis) camps, was one of the actively developed areas. In 1919 the shipments from 18 mines were 6,291 tons of galena and 52,870 tons of sphalerite; in 1920 the shipments from 20 mines were 6,847 tons of galena and 70,020 tons of sphalerite from 914,600 tons of ore treated. The sphalerite averaged about 59.8 per cent of zinc content, and the output of galena was proportionately less than in other parts of the Miami district.

The production of the mines in the vicinity of Picher showed an increase in 1920. In 1919 the quantity of ore milled was 2,373,100 tons, and the shipments were 31,029 tons of galena and 129,302 tons of sphalerite. In 1920 the quantity of ore milled was 2,966,600 tons and the shipments were 38,397 tons of galena and 164,884 tons of

sphalerite, which indicates a recovery of approximately 6.85 per cent in concentrates.

New concentrating plants were built in 1920 by the Aztec Mining Co. (200 tons), Leonora Mining Co. (100 tons), St. Louis Smelting & Refining Co. (Kropp, 300 tons), Wolverine Mining Co. (200 tons), and Waxahachie Mining Co. (200 tons). Flotation plants were installed by the Woodchuck Zinc Lead Co., Vinegar Hill Zinc Co. (Wilson mine), and Black Eagle Mining Co. Several mills were destroyed by fire in 1920, including one belonging to the Niangua Mining Co. and another to the Omaha Lead & Zinc Co. Tailing mills owned by Miller & Worley and the Dudley Milling Co. were also burned.

WISCONSIN.

By J. P. Dunlop.

Mine production of lead and zinc in Wisconsin in 1920, by districts.

District.	Ores.					
	Lead concentrates.		Zinc concentrates.			
			Sphalerite.		Silicate and carbonate.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Benton—New Diggings	1,953	$182,415	48,318	$1,284,538	.....	.....
Cuba City	730	65,092	11,211	209,330	.....	.....
Dodgeville	35	3,500	157	3,913	.....	.....
Hazel Green	40	3,464	4,347	105,846	.....	.....
Highland and Mineral Point	79	7,945	33	1,046	1,943	$41,481
Linden	162	15,345	1,649	44,260	.....	.....
Livingston and Mifflin	272	24,895	31,619	493,577	.....	.....
Platteville and Potosi	79	7,497	1,718	81,267	.....	.....
Shullsburg	176	16,624	2,935	84,924	.....	.....
Total, 1919	3,526	326,777	101,987	2,308,701	1,943	41,481
	5,646	359,795	134,249	2,940,280	5,833	111,858

District.	Metal content.[a]			
	Lead.		Zinc.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Benton—New Diggings	1,482	$237,120	14,477	$2,345,274
Cuba City	528	84,480	2,390	387,180
Dodgeville	27	4,320	41	6,642
Hazel Green	32	5,120	1,306	211,572
Highland and Mineral Point	61	9,760	451	73,062
Linden	125	20,000	537	86,994
Livingston and Mifflin	205	32,800	6,228	1,008,936
Platteville and Potosi	62	9,920	927	150,174
Shullsburg	125	20,000	928	150,336
Total, 1919	2,647	423,520	27,285	4,420,170
	4,214	446,684	40,765	5,951,690

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses in the case of zinc but not in the case of lead. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price of all grades.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1919 and 1920.

		1919	1920
Total crude ore	short tons	1,826,200	1,742,000
Total concentrates in crude ore:			
Lead	per cent	0.31	0.20
Zinc	do	7.67	5.96
Metal content of crude ore:			
Lead	do	.24	.15
Zinc	do	2.71	1.93
Average lead content of galena concentrates	do	74.6	75.0
Average zinc content of sphalerite concentrates	do	35.3	32.4
Average zinc content of zinc carbonate concentrates	do	34.6	26.6
Average value per ton:			
Galena concentrates		$63.73	$92.68
Sphalerite concentrates		$21.90	$22.64
Zinc carbonate concentrates		$19.18	$21.35

The lead and zinc mines of Wisconsin are in Grant, Iowa, and Lafayette counties and comprise the most important part of the ore deposits of the upper Mississippi Valley region, a historical review of which is given in the Illinois section of this report in Mineral Resources for 1914. A detailed description of the Wisconsin lead and zinc districts and of the mines in each district to the year 1906 is given by Bain.[11]

Although mining development has continued and many new mines have been opened, worked out, and abandoned, the area of the mining region has not been enlarged to any extent. The development of the mines subsequent to Bain's report and the output of Wisconsin mines have been given in the reports in Mineral Resources of the United States for the years 1907 to 1919.

The galena of the district is nonargentiferous, and so far as known the zinc ores are free from cadmium. In some of the mines marcasite is so plentiful that the zinc blende concentrates are reduced to a very low grade. Owing to their nearness in specific gravity, marcasite and blende are very difficult to separate cleanly by hydraulic methods.

Roasting and electromagnetic separation have been utilized in the district for many years to produce a marketable zinc product. Comparatively few of the concentrating plants are equipped with roasters, but practically all the larger mining interests own or control separating plants.[12]

The roasting and separating plants operated in Wisconsin in 1920 were those of the Mineral Point Zinc Co., at Mineral Point; the Champion plant of the Wisconsin Zinc Co., at New Diggings; the National Zinc Separating Co. and the Linden Zinc Co., at Cuba City; and the Blockhouse Mining Co., at Platteville.

Approximately 122,000 tons of sphalerite concentrates were shipped in 1920 from mines in the upper Mississippi Valley region (Illinois and Wisconsin), and of this quantity about 117,000 tons was treated at roasting and separating plants in Wisconsin. The average zinc content of the raw sphalerite concentrates sold in 1920 was 32.4 per cent, and the average price per ton was $22.64; the corresponding content and price for 1917 were 32.8 per cent and $29.48; for 1918, 34.6 per cent and $25.70; and for 1919, 35.3 per cent and $21.90.

The percentage of concentrates recovered from crude ore is much higher in Wisconsin than in the Joplin region, but the raw zinc

[11] Bain, H. F., Zinc and lead deposits of the upper Mississippi Valley: U. S. Geol. Survey Bull. 294, pp. 81–148, 1906.

[12] Deutman, E. G., The roasting and magnetic separation of Wisconsin zinc ores: Eng. and Min. Jour., June 28, 1919, pp. 1107–1111.

concentrates average 21 to 27 per cent less in zinc content. On account of these conditions, at many mines no close recovery is made and the tailings can seldom be profitably reworked. In 1920, however, large quantities of tailings were treated at the Champion, C. A. T., Longhorn, Blackstone, Laurence, Winskill, Lucky Six, and Burr mines and also at small tailing plants built and operated at the Field and Federal mines. The new concentrating plants are equipped with more tables than formerly, though the concentrates from the tables have a very high iron content, but this can be remedied by roasting.

The crude ore yields from 5 to more than 20 per cent of concentrates. The average recovery in concentrates decreased from 7.98 per cent in 1919 to 6.16 per cent in 1920, which was a natural reflection of the decreased quantity of crude ore milled and the unusually large quantity of old tailings treated. The mining methods are largely determined by the mode of occurrence of the ores but otherwise are similar to those in vogue in working the pockety ores at Joplin. The milling methods used in the Wisconsin field have been described by Walter Schultz,[13] of the Wisconsin Zinc Co.

The zinc-carbonate ore, which is mined almost entirely in the Highland and Mineral Point districts, is purchased mainly by the Mineral Point Zinc Co. and made into zinc oxide in the plant at Mineral Point, Wis. The production of carbonate ores decreased greatly, and the Mineral Point Zinc Co. has demolished all its mills at Highland.

The metal content of the raw sphalerite concentrates sold by the mines in 1920 ranged from 20 to 59 per cent but in most of the concentrates sold was between 25 and 38 per cent. The zinc content of the roasted sphalerite concentrates shipped ranged from 59 to 61 per cent.

The value of the mine output of lead and zinc in Wisconsin for the year 1920 was $4,843,690, against $6,398,374 in 1919. The lead concentrates sold decreased from 5,646 tons in 1919 to 3,526 tons in 1920, and the sphalerite concentrates sold decreased from 134,249 to 101,987 tons. The zinc-carbonate concentrates shipped decreased from 5,833 to 1,943 tons. The metal content of the lead concentrates was 1,567 tons less than in 1919. The recoverable zinc content of the sphalerite and zinc-carbonate concentrates decreased 13,480 tons.

Thirty-two milling plants were in operation during 1920, but nearly all these plants were idle at the end of the year. Very little development work was done and very few new mines were opened. As in all other mining regions during 1920, labor was scarce until the last part of the year, costs of mining and milling did not appreciably decline, and prices for lead and zinc decreased, so that the small operators suspended work and the larger operators closed nearly all their plants.

The larger mining interests in the Wisconsin field, which include the Mineral Point Zinc Co., Wisconsin Zinc Co., Vinegar Hill Zinc Co., and Frontier Mining Co , had a combined output approximately equal to 60 per cent of all the lead concentrates and 77 per cent of all the zinc concentrates shipped from Wisconsin mines in 1920. Mines con-

[13] Schultz, Walter, Milling Wisconsin lead-zinc ores: Eng. and Min. Jour., July 14, 1917, pp. 82–84.

trolled by the Blockhouse Mining Co., Connecting Link Mining Co., Rodham McQuitty Mining Co., and Zinc Hill Mining Co. contributed most of the remainder of the sphalerite shipped. The only districts in Wisconsin that had a larger production of zinc concentrates in 1920 than in 1919 were Cuba City and Livingston. For descriptions of the old mines and concentrating plants on which no essential changes were made during 1920 the reader is referred to Mineral Resources for recent years.

The Benton-New Diggings district produced about 55 per cent of the galena and more than 47 per cent of the sphalerite shipped from Wisconsin in 1920. Its output was about 36,000 tons less than in 1919. The shipments from the Benton part of the Benton-New Diggings district were 855 tons of galena and 4,714 tons of sphalerite, a decrease of fully two-thirds. The shipments from New Diggings camp were 1,098 tons of galena and 43,604 tons of sphalerite. The large producing properties in this district were the Champion, Blackstone, Longhorn, and C. A. Thompson mines of the Wisconsin Zinc Co., the Hoskins and Penna-Benton mines of the Mineral Point Zinc Co., the Fields-Meloy mine of the Vinegar Hill Zinc Co., the Indian Mound of the Laurence Mines Co., the Bearcat, Middi, and Robson mines of the Frontier Mining Co., and the Imperial Mining Co.

All the production in the Cuba City district in 1920 was that of the Connecting Link Mining Co. (two mills) and of the Big Dick and Little Dick mines of the Zinc Hill Mining Co.

The producing mines in the Hazel Green district were the Monmouth and Jefferson, and there was a considerable quantity of concentrates made from old tailings by the Scrabble Creek Tailing Co. and P. D. Camphinus.

The only large shippers in the Highland district were the Highland and Lampe mines. Only one milling plant was operated by the Mineral Point Zinc Co.

The shipment of sphalerite from the Livingston and Mifflin districts in 1920 was 31,619 tons, 8,462 tons more than in 1919. The only large producing mines were Coker Nos. 1 and 2 of the Mineral Point Zinc Co., and the Yewdall and Dale Rundell mines of the Vinegar Hill Zinc Co.

Mines in the Platteville and Potosi districts shipped 1,718 tons of sphalerite in 1920, nearly all of which was shipped by the Blockhouse Mining Co.

The only shippers of concentrates in the Linden district were the Fearless Mining Co., McKay Mining Co., J. P. Williams, and Launder & Co.

The production of both galena and sphalerite from mines in the Shullsburg district was much less than in 1919, and considerable quantities of galena and sphalerite were held in bins at the end of 1920. Nearly all the shipments were those of the Rodham McQuitty Mining Co. and the Winskill Mining Co.

The new mills erected in 1920 were the Fields-Meloy of the Vinegar Hill Zinc Co., at New Diggings; the Connecting Link No. 2, at Cuba City; the Nightingale, at Benton; and the Dodgeville Mining Co., at Dodgeville. The sulphuric-acid plant at Cuba City, which had been nearly completed by the Government in 1917, was purchased, completed, and operated by the National Zinc Separating Co.

GOLD, SILVER, AND LEAD IN SOUTH DAKOTA.

(MINES REPORT)

By Charles W. Henderson.

PRODUCTION.

Of the seven producing mines in South Dakota in 1920 three were deep and four placer, a decrease of six deep mines and an increase of one placer. The ore mined and treated yielded in recovered gold 0.1668 ounce or $3.45 a ton, as compared with $3.65 a ton in 1919. The mills of the State treated 1,356,079 tons of ore, which yielded as bullion $4,673,514 in gold and 87,319 fine ounces of silver, valued at $95,178, an average recovery per ton of $3.45 in gold and 0.064 ounce in silver, as compared with $3.62 in gold and 0.086 ounce in silver in 1919.

Mine production of gold, silver, and lead in South Dakota in 1919 and 1920.

Year.	Number of mines producing.	Ore.	Gold.[a]		Silver.[a]		Lead.		Total value.
			Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
		Short tons.	*Fine ounces.*		*Fine ounces.*		*Pounds.*		
1919	12	1,330,368	235,249.57	$4,863,040	116,493	$130,472	32,547	$1,725	$4,995,237
1920	7	1,356,189	226,224.23	4,676,470	90,795	98,966	12,812	1,025	4,776,461
Increase or decrease, 1920	−5	+25,821	−9,025.34	−186,570	−25,698	−31,506	−19,735	−700	−218,776

[a] Includes placer production.

Gold and silver bullion produced at mills in South Dakota in 1920.

Process.	Ore treated.	Gold in bullion.	Silver in bullion.	Quicksilver used.	Sodium cyanide used.	Cyanamid used.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Amalgamation	1,274,944	148,018.30	42,863	8,660	.....	.....
Cyanidation	[a] 1,326,554	78,062.93	44,456	.....	313,149	51,946
	.....	226,081.23	87,319	8,660	313,149	51,946

[a] Includes 1,245,419 tons of tailings from the ore amalgamated.

Mine production of gold and silver in South Dakota, 1876–1920.[a]

Period.	Gold.	Silver.		Total value (commercial).
		Quantity.	Commercial value.	
		Fine ounces.		
1876–1880	$11,255,843	80,292	$92,452	$11,348,295
1881–1890	30,800,000	1,472,580	1,515,224	32,315,224
1891–1900	48,005,555	1,729,873	1,155,691	49,161,246
1901–1910	65,242,196	1,790,365	1,013,349	66,255,545
1911	7,439,874	203,755	107,990	7,547,864
1912	7,891,370	206,460	126,973	8,018,343
1913	7,319,294	172,702	104,312	7,423,606
1914	7,333,508	176,642	97,683	7,431,191
1915	7,406,305	199,864	101,331	7,507,636
1916	7,460,644	215,205	141,605	7,602,249
1917	7,364,233	186,765	153,894	7,518,127
1918	6,565,337	159,202	159,202	6,724,539
1919	4,863,040	116,493	130,472	4,993,512
1920	4,676,470	90,795	98,966	4,775,436
	223,623,669	6,800,993	4,999,144	228,622,813

[a] For yearly output and authority for each, see U. S. Geol. Survey Mineral Resources, 1913, pt. 1, p. 240, 1914.

Mine production of gold, silver, and lead in South Dakota in 1920, by classes of ore.

Source.	Number of mines.	Ore.	Gold.	Silver.	Lead.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*
Deep mines:					
Dry gold ore	2	1,356,098	226,189.74	88,534	.....
Lead oxide ore	1	91	6.58	2,256	12,812
	3	1,356,189	226,196.32	90,790	12,812
Placer mines	4	.....	27.91	5	.....
	7	1,356,189	226,224.23	90,795	12,812

MINING INDUSTRY.

The first four months of 1920 were occupied at the Homestake mine in the continuation of unwatering, begun in December, 1919, after the fire was extinguished by flooding. By March 11 920 of the 1,020 stamps were in operation. Labor shortage continued throughout the greater part of the year, and none of the Homestake mills were operated at full capacity during the summer and fall and one of them, the Monroe mill, was idle from August 16 to December 1. In November the labor supply improved, and before the end of the year it was equal to the demand. The Trojan mine was the only other large property operated in 1920. Minor operations are noted in the review by counties.

REVIEW BY COUNTIES.

CUSTER COUNTY.

Only development work, with no production, was done at the mines in Custer County in 1920.

LAWRENCE COUNTY.[a]

Mine production of gold, silver, copper, and lead in Lawrence County, S. Dak., 1916–1920.

Year.	Number of mines producing.	Ore.	Gold.[b]	Silver.[b]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1916	29	1,870,572	$7,455,136	215,127	.....	35,406	$7,599,127
1917	24	1,868,143	7,360,266	186,436	736	60,905	7,519,328
1918	13	1,781,661	6,564,850	158,108	2,996	11,536	6,724,517
1919	5	1,329,928	4,863,013	116,010	.....	6,585	4,993,293
1920	7	1,356,189	4,676,470	90,795	.....	12,812	4,776,461
Increase or decrease, 1920	+2	+26,261	−186,543	−25,215	.....	+6,227	−216,832

[a] For information on the geology of this county, see Irving, J. D., Ore deposits of the northern Black Hills: U. S. Geol. Survey Bull. 225, pp. 123–140, 1904; Irving, J. D., and Emmons, S. F., Economic resources of northern Black Hills: U. S. Geol. Survey Prof. Paper 26, pp. 53–212, 1904.

[b] Includes both placer and deep mines.

The total value of the product of the Homestake Mining Co. from 1875 to 1920 is $169,434,159.49, and $42,422,344.29 has been paid in dividends.

Production of Homestake mine, 1916–1920.

Year.	Ore milled.	Value of product.	Value per ton.	Dividends.
	Short tons.			
1916	1,600,220	$6,531,003.34	$4.0813	$2,210,208.00
1917	1,677,623	6,619,573.94	3.9458	1,959,048.00
1918	1,628,630	5,916,890.31	3.6330	1,506,960.00
1919	1,192,588	4,346,115.79	3.6443	1,130,220.00
1920	1,274,944	4,410,193.73	3.4591	.....

The annual report of the Homestake Mining Co., dated December 31, 1920, says:

Betterments for the year are as follows:

Powder storage magazine completed and grounds enclosed by a substantial fence.

Supplies warehouse enlarged and grounds fenced.

Drill sharpening shop built near Ellison hoist now ready for occupancy.

Ellison electric hoist; hoisting machinery all on foundations; headframe erected and underground skip pockets now being excavated will be in operation in 1921. Upon the completion of this work the company will have two completely equipped hoisting shafts.

The mine engineers report as follows:

Development drifts driven 4,808 feet, development raises driven 2,929 feet.

No shaft sinking during the year.

There are 1,537,965 tons of ore broken down and remaining in the stopes.

The Trojan mine and 400-ton cyanidation mill were operated continuously during the year. The Trojan property is opened by a vertical shaft 308 feet deep and six adits aggregating 6,000 feet. A small quantity of custom ore was treated at the mill. The Golden Reward, Mogul, and New Reliance mines and mills remained closed.

In the Bear Butte district several carloads of lead-silver ore were shipped from the New Silver Queen mine.

In the Carbonate district development work was continued at the Iron Hill properties, former producers of silver ores. The development work for the last two years has included the driving of a long

drainage adit, which late in 1920 reached the old Iron Hill workings at the 300-foot level and drained the property. Underground development was then begun.

In the Rawlings district, near Tinton, 27.91 fine ounces of placer gold was produced from several placers, most of them in Bear Gulch and Potato Creek.

PENNINGTON COUNTY.

Assessment and development work only was done in the various mining districts in Pennington County in 1920.

GOLD, SILVER, AND COPPER IN WYOMING.

(MINES REPORT.)

By Charles W. Henderson.

PRODUCTION.

No gold, silver, or copper was produced at mines in Wyoming in 1920. From the dump of a copper prospect in the Afton district, Lincoln County, a small lot of copper ore was shipped but its content of silver and copper was too small to be considered in this report. The total output therefore remains the same as given in the report for 1919.

Mine production of gold, silver, and copper in Wyoming, 1842–1920.[a]

Period.	Ore.	Gold.	Silver.		Copper.		Total value.
		Value.	Quantity.	Commercial value.	Quantity.	Value.	
	Short tons.		*Fine ounces.*		*Pounds.*		
1842–1866	.....	(b)	.....	.....	.....	.....	.....
1867–1870	.....	$396,100	3,170	$4,098	.....	.....	$400,198
1871–1880	.....	400,000	3,240	4,115	.....	.....	404,115
1881–1890	.....	67,500	2,940	3,126	1,395,287	$230,521	301,147
1891–1900	.....	131,700	1,400	943	7,541,647	1,257,649	1,390,292
1901–1910	.....	130,259	45,983	26,896	16,906,466	2,579,095	2,736,250
1911	3,491	19,200	725	384	130,499	16,312	35,896
1912	2,439	22,235	265	163	25,080	4,138	26,536
1913	4,236	24,184	957	578	385,239	59,712	84,474
1914	423	5,006	116	64	17,421	2,317	7,387
1915	4,216	14,592	840	426	447,246	78,268	93,286
1916	8,876	20,566	5,524	3,635	2,610,622	642,213	666,414
1917	6,335	3,762	3,415	2,814	2,027,857	553,695	560,181
1918	2,870	871	965	965	852,777	210,636	212,472
1919	798	84	151	169	139,900	26,021	26,274
1920	.....	.....	.....	.....	.....	.....	.....
	.....	1,236,059	69,691	48,376	32,480,041	5,660,487	6,944,922

[a] For yearly output, 1842–1914, see U. S. Geol. Survey Mineral Resources, 1914, pt. 1, pp. 248–9, 1916.
[b] Small; unknown.

REVIEW BY COUNTIES.

Albany County.—The Electrolytic Copper Co., controlling the Iron Blossom, Mountain Rest, and Rambler groups, near Albany and Foxpark, reported extensive development work. In the Electrolytic or Rambler mine (a former producer of copper ores carrying platinum, palladium, gold, and silver) this company discovered the northern continuation of the Rambler vein as faulted from the former workings.

The Native Copper Mining Co., at Tie Siding, continued development to December, when water closed the property until pumps can be installed to allow sinking from 125 to 300 feet. At the property of the Colowyo Gold Mining Co., at Centennial, the development adit was extended from 380 to 780 feet.

Fremont County.—The Carissa mine, at Atlantic City, was kept unwatered during the year.

Goshen County.—Development work was done at the Copper Bottom mine, in the Muskrat Creek district.

Lincoln County.—In the Afton district, 30 miles northeast of Cokeville, at the McKinney mine, development work is reported to have opened up copper ore.

Platte County.—No copper ore was shipped from the Sunrise iron mine of the Colorado Fuel & Iron Co., from which much copper ore had been shipped during 1915–1919.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA.

(MINES REPORT.)

By Charles G. Yale.

INTRODUCTION.

The general condition of the metal-mining industry in California in 1920 was less favorable than in many years. As in the other Western States, the high cost of skilled labor and supplies, the burden of war taxation, high freight rates, labor-union troubles, etc., caused numerous mines to close and others to curtail operations. In total value the metal output of the State in 1920 was $3,228,238 less than in 1919. The decrease was due entirely to a smaller output of gold and copper, for increases are shown in silver, lead, and zinc. Several of the larger and almost all the smaller copper properties were unproductive. The larger gold operators curtailed operations, many as much as 50 per cent; others ceased work for the time; and several closed down permanently and allowed the mines to fill with water. The smaller deep gold mines operated decreased in number and made smaller outputs. The reports received from placer mines, dredge, hydraulic, drift, and surface, were discouraging, the total gold from these sources being $972,463 less than in 1919. The deep mines were even more unfavorably affected, the decrease for the year being $1,412,449 as compared with 1919. The cost of producing gold at the deep mines has risen steadily until it has become almost prohibitive under present conditions. The cost has gone up from $9.51 an ounce in 1913 to $19.15 an ounce in 1920, even among the larger mines with fully equipped and carefully managed reduction plants. This condition has stopped or lessened operations at many gold mines, more particularly the deep ones; but it has affected the gravel mines also.

In the five Mother Lode counties of the State, one of which contains the deepest gold mines, about 38 per cent of the total ore milled or shipped was treated at gold milling plants. The output of siliceous ore in these counties was over 300,000 tons less than in 1919.

The average value of all metals from ores of the State in 1920 was $10.20 a ton, as compared with $8.24 a ton in 1919. From ordinary ore sent to gold and silver mills the recovery was $8.34 a ton in gold and $0.159 in silver, compared with $5.927 and $0.118 in 1919. The recovery from the concentrates treated was $24.215 a ton in gold and $6.343 in silver. Crude ores of all kinds sent to smelters averaged $8.278 in gold and $45.47 in silver. Old tailings treated—33,540 tons—averaged $1.501 in gold and $0.766 in silver.

The details of mining work in the Mother Lode counties of California are given in the section on production by counties. A condensed statement is given in the following table:

Gold and silver produced at gold mills in Mother Lode counties in California in 1920.

County.	Total ore sold or treated (short tons).	Ore treated at gold milling plants (short tons).	Gold and silver recovered in bullion.		
			Gold.	Silver (fine ounces).	Average value in gold and silver per ton of ore.
Amador	220,947	220,945	$1,320,010	13,685	$6.04
Calaveras	191,152	133,943	846,487	6,111	6.37
Eldorado	428	428	4,408	35	10.39
Mariposa	28,659	28,659	228,942	2,737	8.09
Tuolumne	56,541	56,541	158,750	4,791	2.90
	497,727	440,516	2,558,597	27,359	5.87

County.	Concentrates produced.				Value of total recovery.	
	Quantity (short tons).	Gold.	Silver (fine ounces).	Average value in gold and silver per ton of concentrates.	Total.	Average per ton of ore.
Amador	3,626	$375,236	3,884	$104.65	$1,714,396	$7.76
Calaveras	4,526	359,095	2,172	79.86	1,214,610	9.07
Eldorado	1	207	51	263.00	4,709	11.00
Mariposa	443	32,488	1,577	77.22	266,132	9.29
Tuolumne	6,434	95,819	720	15.01	260,576	4.61
	15,030	862,845	8,404	58.02	3,460,423	7.85

All these counties show a lessened output of siliceous ore in 1920, as compared with 1919. The 440,516 tons treated in 1920 yielded $3,460,423, or an average of $7.85 in gold and silver, as compared with 780,673 tons in 1919, yielding $4,894,839, or $6.27 a ton; and 845,802 tons in 1918, yielding $4,334,061, or $4.27 a ton. The average value per ton is very much higher in 1920 than in any preceding year since 1912.

The total quantity of ore treated at gold and silver mills from the deep mines of the State was 721,180 tons, which was 348,830 tons less than in 1919.

Crude ore sold or treated in California in 1920, in short tons.

County.	Siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Total.
Alpine and Modoc [a]	81				81
Amador	220,947				220,947
Butte	776				776
Calaveras	134,168	56,984			191,152
Eldorado	428				428
Fresno	4				4
Humboldt	10				10
Imperial, Los Angeles, and Orange [a]	258		39		297
Inyo	1,107	4	28,425	909	30,445
Kern	5,346				5,346
Madera	757	385			1,142
Mariposa	28,659				28,659
Mono	3,198		177		3,375
Nevada	264,613				264,613
Placer	10,343				10,343
Plumas	7,852	282,004			289,856
Sacramento	1				1
San Bernardino	29,663		1,015		30,678
Shasta	1,457	6,088	120		7,665
Sierra	19,989				19,989
Siskiyou	243	736			979
Trinity	1,695				1,695
Tuolumne	56,541				56,541
	[b] 788,136	346,201	29,776	909	1,165,022
Increase or decrease, 1920	−424,006	−140,232	+14,124	+225	−549,889
Average value per ton in gold and silver	$10.80	$0.68	$11.05		$7.79

[a] Counties combined to avoid disclosure of individual output. [b] Includes 29,908 tons of silver ore.

Value of ore mined and treated in California in 1920.

Class.	Ore (short tons).	Total value.		Average value per ton.	
		In gold and silver.	In all metals.	In gold and silver.	In all metals.
Siliceous	[a] 788,136	$8,514,256	$8,517,017	$10.80	$10.81
Copper	346,201	234,389	2,556,512	.68	7.38
Lead	29,776	329,090	736,618	11.05	24.74
Zinc	909		70,309		77.35
	1,165,022	9,077,735	11,880,456	7.79	10.20
Value in 1919			14,137,547		8 24

[a] Includes 29,908 tons of silver ore, carrying $73,626 in gold, 1,122,912 ounces of silver, 2,897 pounds of copper, and 8,600 pounds of lead.

Gold and silver produced in California in 1920, by methods of treatment.

County.	Ore to gold and silver mills.			Ore to concentrating mills.	Concentrates produced.		
	Quantity.	Gold.	Silver.		Quantity.	Gold.	Silver.
	Short tons.		*Fine ounces.*	*Short tons.*	*Short tons.*		*Fine ounces.*
Alpine and Modoc [a]	80	$682	37				
Amador	205,005	1,278,723	13,273		3,624	$372,880	3,864
Butte	451	2,955	23				
Calaveras	133,943	846,487	6,111	56,624	6,595	359,095	4,512
Eldorado	428	4,408	35		1	207	51
Fresno	3	124	3				
Humboldt	10	103	1				
Imperial, Los Angeles, and Orange [a]	40	600	6				
Inyo	804	4,905	72	14,679	1,456	15,959	52,578
Kern	5,330	59,927	5,287		3	82	1,259
Madera	757	3,018	110		11	1,282	259
Mariposa	28,659	228,942	2,737		443	32,488	1,577
Mono	2,675	13,501	12,861				
Nevada	264,604	2,847,712	53,250		62	10,943	291
Placer	10,338	61,069	928		82	5,127	450
Plumas	7,852	59,767	504	281,994	16,750	26,635	138,843
Sacramento	1	289	2				
San Bernardino	1,381	21	1,259	920	99	496	14,338
Shasta	1,454	10,297	584	4,000	2,511	889	2,818
Sierra	19,989	417,594	3,546				
Siskiyou	242	4,776	59				
Trinity	1,692	19,102	235				
Tuolumne	35,442	150,089	4,703	20,309	6,434	95,819	720
	721,180	6,015,091	105,626	378,526	38,071	921,902	221,560
Average value per ton		$8.34	$0.16			$24.22	$6.34

County.	Crude ore to smelter.			Old tailings treated.		
	Quantity.	Gold.	Silver.	Quantity.	Gold.	Silver.
	Short tons.		*Fine ounces.*	*Short tons.*		*Fine ounces.*
Alpine and Modoc [a]	1	$41	109			
Amador	2	2,356	20	15,940	$41,287	412
Butte				325	419	4
Calaveras	585	5,354	3,624			
Fresno	1	41	152			
Imperial, Los Angeles, and Orange [a]	107	145	8,065	150		601
Inyo	14,962	34,770	184,899			
Kern	16	310	1,124			
Madera	385	1,839	990			
Mono	700	131,245	18,670			
Nevada	9	1,902	26			
Placer	5	207	147			
Plumas	10	21	341			
San Bernardino	12,042	78,678	1,074,760	16,335		22,475
Shasta	2,211	2,812	28,533			
Siskiyou	737	2,646	4,190			
Trinity	3	703	11			
Tuolumne				790	8,661	88
	31,776	263,070	1,325,661	33,540	50,367	23,580
Average value per ton		$8.28	$15.47		$1.50	$0.77

[a] Counties combined to avoid disclosure of individual output.

Reduction mills in California in 1920.

Mills.	Number of plants.	Crushers.	Number of stamps.	Roller mills.	Tube mills.	Concentrators.	Cyanide plants.	Flotation plants.	Capacity in 24 hours.
									Short tons.
Active	138	53	1,769	23	10	384	24	12	15,008
Inactive	320	46	3,385	43	3	528	21	7	16,996
	458	99	5,154	66	13	912	45	19	32,004

In 1920 California gold and silver mills and concentrating plants treated 1,099,706 tons of ore, yielding altogether $6,936,993 in gold and 327,186 fine ounces of silver, valued at $356,633, a total value of $7,293,626, and an average value of $6.63 a ton in both metals. The average value in 1919 was $5.69 a ton; in 1918 it was $4.27.

The bullion recovered in mills in 1920 amounted to $6,015,091 in gold and 105,626 fine ounces of silver, an average of $8.50 a ton in both metals. From 721,180 tons of milling ore and 378,526 tons of concentrating ore 38,071 tons of concentrates were obtained, containing $921,902 in gold and 221,560 fine ounces of silver, an average value of $30.56 a ton of concentrates.

Of the smelting ores, 31,776 short tons was treated and yielded $263,070 in gold and 1,325,661 fine ounces of silver, valued at $1,444,970. The total yield of gold and silver was $53.75 a ton.

Tailings and slag amounting to 33,540 tons were treated, which yielded an average of $2.27 per ton in gold and silver.

PRODUCTION.

SUMMARY.

Gold, silver, copper, lead, and zinc produced in California, 1915–1920.

Year.	Number mines producing.	Ore.	Gold.[a]	Silver.[b]	Copper.	Lead.	Zinc.	Total value.
		Short tons.		*Fine oz.*	*Pounds.*	*Pounds.*	*Pounds.*	
1915	608	3,002,779	$22,442,296	1,678,756	40,751,625	4,579,245	13,094,032	$32,263,844
1916	589	3,187,642	21,410,741	2,564,354	55,897,118	12,407,493	15,256,485	39,749,263
1917	490	3,003,250	20,087,504	1,775,431	48,153.139	21,868,628	10,872,716	37,685,985
1918	703	2,503,411	16,528,953	1,427,711	47,674,660	13,372,049	5,561,393	31,187,807
1919	650	1,714,911	16,695,955	1,107,189	21,732,507	3,568,267	472,990	22,201,898
1920	500	1,165,022	14,311,043	1,706,327	12,626,272	4,813,510	1,165,509	18,973,660
Increase or decrease, 1920	−150	−549,889	−2,384,912	+599,138	−9,106,235	+1,245,243	+692,519	−3,228,238

[a] Includes placer gold. [b] Includes placer silver.

The 301 deep mines producing in 1920 may be classified by chief metallic product, as follows: Gold, 256; copper, 10; lead, 34; zinc, 1. Included among those classified as gold mines (siliceous ores) are a number of purely silver mines, most of them in San Bernardino and Inyo counties and described in the sections on the respective counties. Of the deep mines there were 47 less gold mines, 32 less copper, 11 more lead, and 1 less zinc than in 1919. Of the 199 placer mines reporting production, 51 were hydraulic, 35 less than in 1919; 40 were dredges, 6 less than in 1919; 45, drift, 24 less than in 1919; and 63, surface or sluicing mines, 16 less than in 1919. The dredges are enumerated by the number of boats at work, some companies operating only one and others several. There were 500 mines of all kinds reporting production in California in 1920.

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Mine production of gold, silver, copper, lead, and zinc in California in 1920.

County.	Ore treated.	Deep-mine gold.		Placer gold.		Total gold.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.	*Fine ounces.*		*Fine ounces.*		*Fine ounces.*	
Alpine and Modoc [a]	81	34.97	$723			34.97	$723
Amador	220,947	82,007.53	1,695,246	4,525.34	$93,547	86,532.87	1,788,793
Butte	776	163.22	3,374	22,471.44	464,526	22,634.66	467,900
Calaveras	191,152	58,579.03	1,210,936	11,068.64	228,809	69,647.67	1,439,745
Eldorado	428	223.25	4,615	423.96	8,764	647.21	13,379
Fresno	4	7.98	165	369.00	7,628	376.98	7,793
Humboldt	10	4.98	103	117.79	2,435	122.77	2,538
Imperial, Los Angeles, and Orange [a]	297	36.04	745			36.04	745
Inyo	30,445	2,691.30	55,634			2,691.30	55,634
Kern	5,346	2,917.93	60,319	41.99	868	2,959.92	61,187
Madera	1,142	296.97	6,139	11.76	243	308.73	6,382
Mariposa	28,659	12,646.68	261,430	19.35	400	12,666.03	261,830
Mono	3,375	7,002.09	144,746			7,002.09	144,746
Nevada	264,613	138,379.44	2,860,557	576.34	11,914	138,955.78	2,872,471
Placer	10,343	3,212.25	66,403	4,096.64	84,685	7,308.89	151,088
Plumas	289,856	4,180.71	86,423	758.23	15,674	4,938.94	102,097
Sacramento	1	13.98	289	76,178.24	1,574,744	76,192.22	1,575,033
San Bernardino	30,678	3,831.06	79,195			3,831.06	79,195
San Joaquin and Stanislaus [a]				8,685.12	179,537	8,685.12	179,537
Shasta	7,665	677.15	13,998	14,459.43	298,903	15,136.58	312,901
Sierra	19,989	20,201.11	417,594	1,223.88	25,300	21,424.99	442,894
Siskiyou	979	359.04	7,422	3,545.16	73,285	3,904.20	80,707
Trinity	1,695	958.07	19,805	25,231.52	521,582	26,189.59	541,387
Tuolumne	56,541	12,314.77	254,569			12,314.77	254,569
Yuba				167,753.32	3,467,769	167,753.32	3,467,769
Total, 1919	1,165,022	350,739.55	7,250,430	341,557.15	7,060,613	692,296.70	14,311,043
	1,714,911	419,066.77	8,662,879	388,600.05	8,033,076	807,666.82	16,695,955
Decrease, 1920	549,889	68,327.22	1,412,449	47,042.90	972,463	115,370.12	2,384,912

County.	Deep-mine silver.		Placer silver.		Total silver.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Fine ounces.*	
Alpine and Modoc [a]	146	$159			146	$159
Amador	17,569	19,150	578	$630	18,147	19,780
Butte	27	29	2,040	2,224	2,067	2,253
Calaveras	14,247	15,529	1,075	1,172	15,322	16,701
Eldorado	86	94	56	61	142	155
Fresno	155	169	53	58	208	227
Humboldt	1	1	17	18	18	19
Imperial, Los Angeles, and Orange [a]	8,672	9,452			8,672	9,452
Inyo	237,549	258,929			237,549	258,929
Kern	7,670	8,360	23	25	7,693	8,385
Madera	1,359	1,481	6	7	1,365	1,488
Mariposa	4,314	4,702	2	3	4,316	4,705
Mono	31,531	34,369			31,531	34,369
Nevada	53,567	58,388	81	88	53,648	58,476
Placer	1,525	1,663	473	515	1,998	2,178
Plumas	139,688	152,260	104	113	139,792	152,373
Sacramento	2	2	4,158	4,532	4,160	4,534
San Bernardino	1,112,832	1,212,987			1,112,832	1,212,987
San Joaquin and Stanislaus [a]			917	1,000	917	1,000
Shasta	31,935	34,809	1,609	1,754	33,544	36,563
Sierra	3,546	3,865	94	102	3,640	3,967
Siskiyou	4,249	4,632	538	586	4,787	5,218
Trinity	246	268	2,937	3,201	3,183	3,469
Tuolumne	5,511	6,007			5,511	6,007
Yuba			15,139	16,502	15,139	16,502
Total, 1919	1,676,427	1,827,305	29,900	32,591	1,706,327	1,859,896
	1,079,265	1,208,776	27,924	31,275	1,107,189	1,240,051
Increase, 1920	597,162	618,529	1,976	1,316	599,138	619,845

[a] Counties combined to avoid disclosure of individual output.

Mine production of gold, silver, copper, lead, and zinc in California in 1920—Contd.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Alpine and Modoc[a]							$882
Amador							1,808,573
Butte							470,153
Calaveras	2,111,119	388,446					1,844,892
Eldorado							13,534
Fresno							8,020
Humboldt							2,557
Imperial, Los Angeles, and Orange[a]			15,610	$1,249			11,446
Inyo	131,630	24,220	4,607,516	368,601	868,009	$70,309	777,693
Kern							69,572
Madera	89,678	16,501					24,371
Mariposa							266,535
Mono	4,701	865	85,144	6,811			186,791
Nevada							2,930,947
Placer							153,266
Plumas	9,579,105	1,762,555					2,017,025
Sacramento							1,579,567
San Bernardino	1,080	199	73,495	5,880			1,298,261
San Joaquin and Stanislaus[a]							180,537
Shasta	513,620	94,506	31,745	2,540	297,500	24,097	470,607
Sierra							446,861
Siskiyou	195,339	35,942					121,867
Trinity							544,856
Tuolumne							260,576
Yuba							3,484,271
Total, 1919	12,626,272	2,323,234	4,813,510	385,081	1,165,509	94,406	18,973,660
	21,732,507	4,042,246	3,568,267	189,118	472,990	34,528	22,201,898
Increase or decrease, 1920	−9,106,235	−1,719,012	+1,245,243	+195,963	+692,519	+59,878	−3,228,238

[a] Counties combined to avoid disclosure of individual output.

GOLD.

The mine production of gold in California in 1920 is shown in the table on page 164. Of the deep-mine gold 99 per cent was derived from siliceous ore. Of the placer gold the dredges yielded $816,553 less than in 1919; the hydraulic mines $118,599 less; the drift mines $22,416 less; and the surface placers $14,895 less. From 1898, when gold dredging began in California, to the end of 1920 the total gold output from that source has been $117,236,197. Since 1898 the Oroville or Feather River dredging field, in Butte County, has yielded $31,338,086, not including $2,496,890 derived in the last 11 years from adjacent fields in the same county; from 1903 to 1920, inclusive, the Marysville or Yuba River field, in Yuba County, produced $39,511,478; and since 1902 the Folsom or American River field, in Sacramento County, has produced $26,813,403. Dredges have also been operated in several smaller fields in other northern counties of the State.

The placer mines produced more than 49 per cent of the gold yield in 1920 and the deep mines nearly 51 per cent, as compared with 48 and 52 per cent in 1919. The dredges produced 48 per cent of the total gold from all sources in 1920. Of the total placer gold, dredges produced nearly 98 per cent, hydraulic mines 0.9 per cent, drift mines 0.8 per cent, and sluicing mines 0.4 per cent. The larger dredging fields are at Oroville, Butte County; Folsom, Sacramento County; and Hammonton, Yuba County; but dredges are also operated in eight other counties—1 in Amador, 2 in Calaveras, 1 in Placer, 1 in San Joaquin, 4 in Shasta, 2 in Siskiyou, 2 in Stanislaus, and 4

in Trinity County. Forty dredges reported production in California in 1920, or 6 less than in 1919, and several of these quit work before the end of the year, having worked out their ground. The Yuba County dredges, 10 in number, made the largest output of gold in 1920, but showed a decrease of $729,474 from 1919. Sacramento County, with 9 dredges at work, showed a decrease of $137,961. In Butte County (including Oroville and the "outside districts") 4 dredges produced $80,046 more than in 1919.

Mine production of gold in California in 1920, by sources, in fine ounces.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Total.	
Alpine and Modoc [a]	.....	34.97	.....	.....	.....	34.97	34.97
Amador	4,525.34	82,007.53	.....	.....	.....	82,007.53	86,532.87
Butte	22,471.44	163.22	.....	.....	.....	163.22	22,634.66
Calaveras	11,068.64	58,320.03	259.00	.....	.....	58,579.03	69,647.67
Eldorado	423.96	223.25	.....	.....	.....	223.25	647.21
Fresno	369.00	7.98	.....	.....	.....	7.98	376.98
Humboldt	117.79	4.98	.....	.....	.....	4.98	122.77
Imperial, Los Angeles, and Orange [a]	.....	29.03	.....	7.01	.....	36.04	36.04
Inyo	.....	254.31	.....	2,436.99	.....	2,691.30	2,691.30
Kern	41.99	2,917.93	.....	.....	.....	2,917.93	2,959.92
Madera	11.76	208.01	88.96	.....	.....	296.97	308.73
Mariposa	19.35	12,646.68	.....	.....	.....	12,646.68	12,666.03
Mono	.....	6,878.10	.....	123.99	.....	7,002.09	7,002.09
Nevada	576.34	138,379.44	.....	.....	.....	138,379.44	138,955.78
Placer	4,096.64	3,212.25	.....	.....	.....	3,212.25	7,308.89
Plumas	758.23	2,891.23	1,289.48	.....	.....	4,180.71	4,938.94
Sacramento	76,178.24	13.98	.....	.....	.....	13.98	76,192.22
San Bernardino	.....	3,809.10	.....	21.96	.....	3,831.06	3,831.06
San Joaquin and Stanislaus [a]	8,685.12	.....	.....	.....	.....	.....	8,685.12
Shasta	14,459.43	533.14	139.03	4.98	.....	677.15	15,136.58
Sierra	1,223.88	20,201.11	.....	.....	.....	20,201.11	21,424.99
Siskiyou	3,545.16	275.06	83.98	.....	.....	359.04	3,904.20
Trinity	25,231.52	958.07	.....	.....	.....	958.07	26,189.59
Tuolumne	.....	12,314.77	.....	.....	.....	12,314.77	12,314.77
Yuba	167,753.32	.....	.....	.....	.....	.....	167,753.32
	341,557.15	[b]346,284.17	1,860.45	2,594.93	.....	350,739.55	692,296.70
Total, 1919	388,600.05	411,139.78	6,137.17	1,784.40	5.42	419,066.77	807,666.82
Increase or decrease, 1920	−47,042.90	−64,855.61	−4,276.72	+810.53	−5.42	−68,327.22	−115,370.12

[a] Counties combined to avoid disclosure of individual output.
[b] Includes 3,561.66 ounces from silver ores.

Value and source of placer gold mined in California in 1920.

County.	Hydraulic.	Dredging.	Drift.	Surface placers.	Total.
Amador	$3,997	$86,967	$2,418	$165	$93,547
Butte	.....	441,650	19,462	3,414	464,526
Calaveras	.....	225,780	1,240	1,789	228,809
Eldorado	.....	.....	3,933	4,831	8,764
Fresno	.....	.....	.....	7,628	7,628
Humboldt	1,935	.....	.....	500	2,435
Kern	661	.....	.....	207	868
Madera	.....	.....	.....	243	243
Mariposa	.....	.....	.....	400	400
Nevada	3,471	.....	8,066	377	11,914
Placer	2,308	71,948	7,285	3,144	84,685
Plumas	8,376	.....	5,886	1,412	15,674
Sacramento	.....	1,574,744	.....	.....	1,574,744
San Joaquin and Stanislaus [a]	.....	179,537	.....	.....	179,537
Shasta	.....	297,488	.....	1,415	298,903
Sierra	19,487	.....	5,813	.....	25,300
Siskiyou	19,508	51,824	664	1,289	73,285
Trinity	6,490	513,976	718	398	521,582
Yuba	.....	3,456,452	7,440	3,877	3,467,769
	66,233	6,900,366	62,925	31,089	7,060,613

[a] Counties combined to avoid disclosure of individual output.

The gold recovered from ore and tailings in California in 1920 was as follows: By amalgamation, 260,393.24 fine ounces; by cyanidation, 48,958.84 fine ounces, a large part of which was derived from the concentrates; from concentrates and ore sent to smelters, 41,387.47 fine ounces. These figures are only approximate, as many small operators keep no separate accounts, and even the larger companies do not always segregate the quantity of gold obtained by methods of treatment. This is especially the condition where larger mills amalgamate in the batteries and on the plates and pass the tailings and concentrates direct to the cyanide plants.

All the placer gold was recovered by amalgamation.

SILVER.

The production of silver in California in 1920 is shown in the table below. The largest output was made by San Bernardino County; Inyo and Plumas counties ranked second and third. Shasta County, for many years the leading producer of silver, ranked fifth in 1920. The increase of silver in California was due to the very large output from the mine of the California Rand Silver (Inc.), in San Bernardino County, which produces silver ore containing some gold. There were 18 mines virtually producing silver only in that county in 1920.

The silver recovered from the ore and tailings treated in 1920 was as follows: By amalgamation, 108,393 fine ounces; by cyanidation, 65,072 fine ounces (part of which was recovered from concentrates); and by ores directly smelted or from concentrates from the flotation process, 1,502,962 fine ounces.

Mine production of silver in California in 1920, by sources, in fine ounces.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Total.	
Alpine and Modoc [a]	.....	146	.....	.....	.....	146	146
Amador	578	17,569	.....	.....	.....	17,569	18,147
Butte	2,040	27	.....	.....	.....	27	2,067
Calaveras	1,075	8,283	5,964	.....	.....	14,247	15,322
Eldorado	56	86	.....	.....	.....	86	142
Fresno	53	155	.....	.....	.....	155	208
Humboldt	17	1	.....	.....	.....	1	18
Imperial, Los Angeles, and Orange [a]	.....	2,436	.....	6,236	.....	8,672	8,672
Inyo	.....	10,595	107	226,847	.....	237,549	237,549
Kern	23	7,670	.....	.....	.....	7,670	7,693
Madera	6	369	990	.....	.....	1,359	1,365
Mariposa	2	4,314	.....	.....	.....	4,314	4,316
Mono	.....	26,717	.....	4,814	.....	31,531	31,531
Nevada	81	53,567	.....	.....	.....	53,567	53,648
Placer	473	1,525	.....	.....	.....	1,525	1,998
Plumas	104	504	139,184	.....	.....	139,688	139,792
Sacramento	4,158	2	.....	.....	.....	2	4,160
San Bernardino	.....	1,098,903	.....	13,929	.....	1,112,832	1,112,832
San Joaquin and Stanislaus [a]	917	.....	.....	.....	.....	.....	917
Shasta	1,609	1,572	29,485	878	.....	31,935	33,544
Sierra	94	3,546	.....	.....	.....	3,546	3,640
Siskiyou	538	227	4,022	.....	.....	4,249	4,787
Trinity	2,937	246	.....	.....	.....	246	3,183
Tuolumne	.....	5,511	.....	.....	.....	5,511	5,511
Yuba	15,139	.....	.....	.....	.....	.....	15,139
	29,900	[b] 1,243,971	179,752	252,704	.....	1,676,427	1,706,327
Total, 1919	27,924	[c] 547,541	349,480	172,209	10,035	1,079,265	1,107,189
Increase or decrease, 1920	+1,976	+696,430	−169,728	+80,495	−10,035	+597,162	+599,138

[a] Counties combined to avoid disclosure of individual output.
[b] Includes 1,122,912 ounces from silver ores.
[c] Includes 48,494 ounces from silver ores.

COPPER.

The mine production of copper in California in 1920 is shown on page 163. The decrease from 1919 was due to the closing of most of the larger copper mines of the State, in Shasta and Calaveras counties, as well as many smaller ones. Plumas County took first rank but produced 1,280,780 pounds less than in 1919. Calaveras County slightly increased its copper output in 1920, but Shasta County produced 7,112,038 pounds less than in 1919.

A total of 346,201 tons of copper ore was produced by 10 copper mines in California in 1920, as compared with 486,433 tons in 1919. The copper ores yielded $234,389 in gold and silver, or $0.677 a ton in precious metals, and had a total recoverable value of $2,556,512, an average of $7.384 a ton.

LEAD.

The mine production of lead in California in 1920 (see p. 163) showed an increase in both quantity and value compared with 1919. The lead ore also yielded gold valued at $53,642 and 252,704 fine ounces of silver. The total recoverable value of the metals from the lead ore treated was $736,618, as compared with $424,836 in 1919.

ZINC.

The mine production of recoverable zinc in California in 1920 (see p. 163) came from Inyo and Shasta counties, the larger part from Inyo. The Shasta County zinc was derived from copper ores.

PRODUCTION BY COUNTIES.

AMADOR COUNTY.

Amador county led the other Mother Lode counties of California in quantity of ore in 1920, though it did not produce half as much as in 1919. The output of ore was 220,947 tons, or 234,386 tons less than 1919. Both Plumas and Nevada counties exceeded Amador in tonnage in 1920. In output of gold, Amador ranked third in the State, being exceeded by Yuba and Nevada counties, but it led the Mother Lode counties. In total value of output of metals Calaveras, another Mother Lode county, exceeded it by reason of its copper production. The gold produced in Amador County in 1920 was valued at $1,788,793, of which $1,695,246 was in gold from deep mines. The silver output of the county was valued at $19,780. There were 25 productive deep mines and 7 placers, including 1 dredge.

All the ore mined and treated in the county was siliceous and averaged $7.76 per ton in gold and silver. This tonnage and average value include the ore and tailings milled and smelted. Only 205,005 tons of ore was treated in gold and silver mills, which yielded $1,278,723 in gold and 13,273 ounces of silver saved as bullion; and 3,624 tons of concentrates were obtained, which yielded $372,880 in gold and 3,864 ounces of silver. The value of the total gold and silver from milling ore was $1,670,283, or $8.15 a ton. The 15,940 tons of old tailings re-treated yielded $41,287 in gold and 412 ounces of silver, a total of $41,736. The 2 tons of ore shipped to the smelter yielded $2,356 in gold and $21 in silver. The placer gold of the county in 1920 was valued at $93,547, or $17,325 less than in 1919.

At Amador City the operations of the Bunker Hill Consolidated Mining Co. were greatly restricted during 1920, and the output was small. This company has a 40-stamp amalgamating and concentrating mill with 24 Frue vanners. The concentrates are shipped to a smelter. The mine of the Treasure Mining Co. is developed by an incline shaft 1,600 feet deep and a winze 800 feet deep. The equipment consists of a 150-ton ball mill for amalgamation and concentration, and the concentrates are shipped to a smelter. The Darrow tailing plant was idle in 1920. At the famous Keystone mine water was allowed to flood the lower levels in July, 1920, when all pumping ceased, so that the mine and 40-stamp mill were idle. The only operations carried on at the Amador mine consisted of pumping water from the mine. A few gold mines were productive near Ione. The Fremont Consolidated mine, at Drytown, was not operated in 1920 but has since been pumped out and milling operations will shortly be resumed. The Argonaut Mining Co., formerly the most productive on the Mother Lode, operated its mine and 60-stamp mill 79 days during 1920. The mine, which has been entirely pumped out since the disastrous fire and flooding, is opened by a vertical shaft 4,850 feet deep. The California Slimes Co. handled all the tailings from the Argonaut mine. The mine of the Kennedy Mining Co. was closed March 5 on account of an underground fire and subsequent flooding and has remained closed ever since. This property is developed by a vertical shaft 4,155 feet deep and has a 100-stamp amalgamating and concentrating mill. The Toronto Gold Reduction Co. worked its tailings dump only. The aggregate amount of gold obtained from a number of small quartz mines in the vicinity of Jackson was considerable. At Plymouth the Plymouth Consolidated Gold Mines (Ltd.) made a heavy production and sunk its shaft 300 feet deeper, making it 3,100 feet deep in all. The milling plant on this property has 40 stamps, two 8-foot Hardinge mills, and 42 vanners, the total capacity being 400 tons daily. The Central Eureka, at Sutter Creek, made a large production in 1920. It is equipped with a 40-stamp amalgamating and concentrating mill. In the old Eureka mine, which has a 3,500-foot inclined shaft, 2,000 feet of drifts and crosscuts were run in 1920. The company, after extensive explorations with diamond drills and other means, has since abandoned the mine, after having expended about a million dollars in reopening operations without finding any profitable ore. Very little deep mining was done at Volcano or other places in Amador County.

Among the few productive placer mines of the county in 1920 were the Wicker, at Amador City, Ludekens, at Pine Grove, and DeVenzini, Mat White, and a few others near Volcano. The most productive placer was that of the American Gold Dredging Co. on Mokelumne River, where one dredge worked three months and another five months. These dredges also worked part of the year on the Calaveras County side of the river, as noted in the review of that county. Considerable platinum and iridium were obtained in these gold-dredging operations.

BUTTE COUNTY.

The total output of gold in Butte County in 1920 was $467,900, of which $464,526 came from placers of various kinds. Of the placer gold output, $441,650 was obtained by 4 dredges, $19,462 from 4

drift mines, and $3,414 from 7 surface or sluicing mines. Butte County, for many years the leading producer of dredge gold, is now exceeded by Yuba, Sacramento, and Trinity counties. A few productive deep mines yielded $3,374 in gold and 27 ounces of silver. Among these is the Triumph, at Enterprise, where there is a stamp mill, Beers grinding mill, amalgamating plates, and a pan.

Mine production of gold in Oroville dredging district, Calif., 1911–1920, with increase or decrease, by years.

Year.	Production.	Increase or decrease.	Year.	Production.	Increase or decrease.
1911	$1,987,294	—$112,334	1916	$970,409	—$200,906
1912	2,080,229	+ 92,935	1917	717,782	— 252,627
1913	1,918,050	— 162,179	1918	527,410	— 190,372
1914	1,422,407	— 495,643	1919	282,844	— 244,566
1915	1,171,315	— 251,092	1920	367,256	+ 84,412

The only dredge operating in an "outside" district in Butte County in 1920 was that of the Pacific Gold Dredging Co. on Butte Creek, 6 miles from Chico. At Oroville, in the Oroville field proper, the Natomas Co. of California operated two dredges, one on its own account and one on a royalty basis on property owned by another company. The American Gold Dredging Co. operated one dredge in this field during 1920. "Snipers" got out some placer gold at Bangor, and the Big Boulder mine produced some gold at Berry Creek. The Big Bend Co. operated for two months only at Las Plumas; and A. A. Davis recovered gold from old dredge tailings at Oroville. Some production was also made by small placers at Enterprise, Oroville, Stirling City, and Nimshew.

CALAVERAS COUNTY.

Calaveras, one of the Mother Lode counties, produced 32,389 tons less ore in 1920 than in 1919 and 296,351 tons less than in 1918. This decline was due to the closing down during the two years of several of the largest mines. The total yield of gold in 1920 was $1,439,745, which was $110,829 less than the yield in 1919. The value of the silver produced was $16,701, or $19,175 less than in 1919. The output of copper was 2,111,119 pounds, or 63,315 pounds more than in 1919. In 1920 there were 36 mines reporting production from the county. Of the deep mines 21 were gold and 3 copper. There were 2 dredges in operation, 1 drift mine, and 9 surface placers. Gold recovered by dredges amounted to $225,780, a decrease of $6,478, as compared with 1919; that from the drift mine was $1,240, a decrease of $2,019; and that from surface placers was $1,789, a decrease of $3,079.

The total quantity of ore sold or treated in Calaveras County in 1920 was 191,152 tons, which yielded gold valued at $1,210,936, silver valued at $15,529, and copper valued at $388,446. The placer output was $228,809 in gold and $1,172 in silver. The total value of the output of the county in gold, silver, and copper was $1,844,892. During the year 133,943 tons of ore was treated at gold and silver mills, from which was obtained $846,487 in gold in bullion and $6,661

in silver. From this ore directly milled and from 56,624 tons of ore sent to concentrating plants was obtained 6,595 tons of concentrates, yielding $359,095 in gold and 4,512 ounces of silver. The recovery of copper from the ore concentrated was 2,039,045 pounds. There were 585 tons of ore smelted, which yielded $5,354 in gold, $3,950 in silver, and 72,074 pounds of copper. The total value of the smelting ore was $22,566, or $38.57 per ton.

At Angels the Angels Camp Deep Mining Co. did not use the 20-stamp amalgamation and concentration mill built in 1919. Development work only was done, no ore being produced. The Utica Mining Co. operated the Gold Cliff mine and a 40-stamp amalgamation and concentration mill only from January 1 to April 30, 1920, when the property was permanently closed. This property, once the most productive in the State and worked continuously for more than half a century, has a vertical shaft 3,400 feet deep. The company still owns the Union ditch, which supplies water and power for the surrounding region. The Angels Quartz, Covello, Gonzales, Agnes Aileen, Bullion, Columbia, El Dorado, Etna King, Jolly Tar, Toll Gate, Triple Lode, and Lightner mines, all of Angels, were nonproductive in 1920. The Lightner mine was being reopened, but work was stopped in September, though shaft sinking is to be resumed. Several of the mines named are continuing development work but not producing or milling ore.

At Campo Seco the Calaveras Copper Co. operated both its mill and smelter during 1920. This company has a 200-ton blast furnace and an oil flotation plant of from 400 to 500 tons capacity. The ore from the mine is crushed and concentrated at the flotation plant, the concentrates are sent to the sintering plant, then to the blast furnace, and the matte to the blister furnace. In 1920 the matte was shipped to the Tacoma smelter. Ore was produced from the mine until September 30, 1920, when the Union shaft equipment and part of the shaft were destroyed by fire, and since then only development work has been done. The mill and blast furnace were operated until December 15, 1920. At that time the company started sinking a new shaft south of the old Union shaft. A small quantity of gold was produced by the Chapparal mine, at Esmeralda, and by the Dean, at Felix. Only 15 stamps of the big mill at the Royal Consolidated mine, at Felix, were dropped in 1920. The Wilbur-Womble mine, at the same place, was unwatered and sampled in 1920, and the surface equipment and shaft were repaired and new mine equipment was put in the south end of the property. The mine was operated for the first half of the year only. Some gold was taken from the Tower pocket mine, at Felix. The mine of the Carson Hill Gold Mines (Inc.), at Melones, was the most productive in the county and one of the most productive deep mines of the State. This mine has a vertical shaft 800 feet deep, one adit 4,000 feet long, and an internal shaft 2,600 feet long on a 55° incline. The company has a 20-stamp amalgamation and concentration mill, with a cyanide plant. Ten stamps have been added since the end of the year. The ore is crushed, stamped, ground in a ball mill, amalgamated, and concentrated on Wilfley vanners; the concentrates are reground and cyanided; and the sands and slimes are cyanided separately. The Quail Hill mine, at Milton, was worked only part of the year.

The Calaveras Mining & Mill Co. (Black Wonder), at Mitchell Mill, did mainly development work but made some output. Its mine is equipped with a Blake crusher, Gibson mill, and concentrators. A small yield in gold was made at the San Bruino, Good Hope, and Monte Cristo mines, at Glencoe, also at the Comet mine, at Railroad Flat. The property of the Montacali Mines Syndicate (Sheep Ranch group), at Sheep Ranch, is developed by an inclined shaft 1,700 feet deep and 4,700 feet of drifts. In 1920 the 1,500 and 1,700 foot drifts were extended east and west and the main shaft was deepened 400 feet. The equipment includes a 20-stamp amalgamation mill, which was run on part time until September, when it was shut down and remodeled to a 100-ton cyanide plant. The Washington mine, at Sheep Ranch, and the Yachua pocket and the small properties tributary to Valley Springs and at West Point produced some gold. The Carson Consolidated Mining Co., at Carson Hill, operated the whole year, with no output, but put up a 10-stamp mill. The Penn Mining Co., at Campo Seco, usually a large producer of copper, kept its 200-ton smelter idle the whole year and did only development work on the mine. The Melones mine, at Melones, usually a very large producer, with a 100-stamp mill, concentrators, and cyanide plant of 250 tons daily capacity, was idle the entire year. The Napoleon copper mine, at Milton, usually a producer, was also idle. The Morning Star Mining Co., formerly known as the Boston mine, made no output in 1920, but built a new reduction plant (daily capacity 125 tons) consisting of two crushers, a ball mill, two Senn amalgamators, an Argall classifier, and Dorr thickeners for flotation plant. The Pacific Gold Mining & Milling Co., with its 100-ton ball mill and concentration plant, was idle the whole year.

The principal placer work in Calaveras County in 1920 was done by the American Gold Dredging Co. on Mokelumne River 3 miles from Camanche. The company operated two California standard electric dredges, one for five months and one for seven months. These dredges operated also for some months on ground on the Amador County side of Mokelumne River. Some little surface placer work was also done near Camanche. The Ivy L. Borden dredge was operated the entire year on Calaveras River near Jenny Lind. Small placers were productive at Jenny Lind, Mokelumne Hill, Mountain Ranch, San Andreas, and Vallecito. The Vallecito Consolidated Mines began work in June, 1920, drifting in the Tertiary gravel of Calaveras River at Vallecito, but made only a small output.

ELDORADO COUNTY.

Eldorado is one of the five Mother Lode counties of California, but its mining industry has been in a decadent condition for some years, no large properties being in operation and no new mines of importance having been opened. Prospecting in the county seems almost at a standstill, and very little development work is being done.

The gold output of the county in 1920 amounted to $13,379,—$8,764 from 14 placers and $4,615 from 6 deep mines. This total is $16,742 less than the gold output of 1919. Only 428 tons of ore was milled. The number of producing mines of all kinds dropped off one-third.

Of the few productive deep mines at Georgetown, the Paymaster, equipped with a Gibson mill, rated at 10 tons in 24 hours, is the most important. The Lucky Strike, at Grizzly Flats, was a small producer. The Guildford, at Placerville, lost its mill by forest fires in 1919 and has been idle since.

The productive placers of Eldorado County in 1920 were the Bishop, at Coloma; Rocky Bar, at Fairplay; Gold Bug and Sailor Slide, at Georgetown; Good Luck, at Latrobe; Hope (Landecker), Pacific Channel, and Rising Hope, at Placerville; and Hook and Ladder, at Smith Flat.

INYO COUNTY.

There were 41 mines reporting production from Inyo County in 1920, all deep, which is 4 more than in 1919. Of these mines, 16 were gold, 1 copper, 23 lead, and 1 zinc. Included in this general classification are 6 mines that produce silver exclusively. The total value of the metallic output in 1920 was $777,693, or $288,075 more than in 1919. The value of the gold was $55,634, or $13,926 less than in 1919. The silver amounted to 237,549 ounces, an increase of 64,200 ounces. Among the California counties Inyo is now only exceeded by San Bernardino County in production of silver. The output of copper was 131,630 pounds, valued at $24,220—26,140 pounds and $5,125 less than in 1919. The output of lead was 4,607,516 pounds, an increase of 1,206,615 pounds. Inyo is the chief lead-producing county of the State, a position it has occupied for many years. The production of zinc in 1920 was 868,009 pounds, valued at $70,309, an increase in quantity of 644,526 pounds.

The ore sold or treated in 1920 in Inyo County amounted to 30,445 tons, of which 1,107 tons was siliceous ore, 4 tons copper ore, 28,425 tons lead ore, and 909 tons zinc ore. Of the gold produced $5,257 was obtained from siliceous ore, $50,377 from lead ore, and none from copper or zinc ore. The production of silver from siliceous ore was 10,595 fine ounces, from copper ore 107 ounces, and from lead ore 226,847 ounces. The siliceous ore yielded $16,806 in gold and silver, the copper ore $117, and the lead ore $297,640. Included in the siliceous ore was 826 tons of purely silver ore from six silver mines, yielding $9,741.

The Big Pine mine, at Big Pine, shipped some lead ore in 1920, and a little gold came from the Blue Monster, Cometti, and Dunlop mines at the same place. The ores from the Inyo Bunker Hill and Montezuma mines are mainly lead ores. The Lincoln and Arrowhead Rico (Ubehebe) mines produced a little silver ore. The Argus Sterling Mining Co., at Darwin, shipped lead ores carrying silver. The Bonita is a small gold mine, and lead-silver ore was shipped from the Buckhorn. The ore from the Darwin Silver Co. (Lucky Jim and Defiance) contained lead, silver, copper, and a little gold. The Black Metals Mining Co. shipped considerable silver ore from the Jackass mine. At this property the ball mill was overhauled and a flotation, electric-light, and pumping plant installed. The Custer, Fernando group, and Grimes & Sexton mines shipped lead-silver ores, the Lee shipped a small quantity of copper ore, and the Rip Van Winkle shipped lead-silver ores. The Utacala Exploration Co. (Towser mine) shipped zinc ore only to the Empire Zinc Co., Utah Zinc Co., and Metals & Chemical Extraction Corporation, Oakland,

Calif., and stopped shipping in December. The Wonder, also at Darwin, was worked the entire year, but only small shipments of lead-silver ore were made. The Barringer, at Keeler, shipped silver ore in 1920. The Cerro Gordo Mines Co. mined no ore in 1920, but a few hundred tons of stock ore carrying lead, copper, silver, and gold was shipped to the Midvale smelter, Utah. The Estella mine was in operation throughout 1920, but production was curtailed November 1 after the increase of railroad freight rates. The ore shipped to the Midvale smelter carried lead, copper, considerable silver, and some gold. The mine is opened through a 7,300-foot adit, 450 feet of tunnel, and a 220-foot shaft, and considerable development work was done in 1920. The Santa Rosa was mined in a small way by the company and by lessees, but some ore containing lead, copper, silver, and gold was shipped to Midvale, Utah. The Silver Reef and Schaffer, at Keeler, and the Carbonate, at Lone Pine, were small producers. Some lead ore was shipped by Fairbanks & Overburg from Shoshone. At Tecopa the Paloma and Arcturus (Ibex) mines made small shipments of lead ore. The Tecopa Consolidated Mining Co. (Gunsite, Noonday, Columbia, and War Eagle mines) had the most productive property in Inyo County in 1920. The main product was lead, but the ore contained considerable silver and gold and a little copper. The mines were closed December 1, 1920, on account of the low price of lead and the excessive costs. The 50-ton concentration mill operated only a small part of 1920. A small quantity of ore was shipped by lessees of the Ibex Spring mine, at Keeler. There are no metal mines at Trona, but it is the shipping point for surrounding mines in Inyo and San Bernardino counties. Among the Inyo County mines shipping from Trona was the Ophir Inyo Mining Co., which operated for 90 days and shipped lead ore containing a little silver. The mine of the Slate Range Minerals Co. (Copper Queen) ranked second among the productive mines of the county and was operated the entire year. It has a 50-ton ball mill for concentration, but part of the ore was shipped crude. Gold ore only was mined by the Stockwell Gold Mining Syndicate, and a little gold was obtained during development work by the Salvage group (Tuba Canyon).

KERN COUNTY.

Twenty-four deep gold mines and two placers reported production from Kern County in 1920. The value of the total metallic output of the county decreased from $158,991 in 1919 to $69,572. The total production of gold decreased from $150,589 to $61,187, owing to the inactivity of the Yellow Aster mine, at Randsburg, formerly the largest producer in the county. The silver output was valued at $8,385, as compared with $8,402 in 1919. No copper, lead, or zinc was produced.

The ore sold or treated in 1920 amounted to only 5,346 tons, all siliceous, of which 5,330 tons was sent to gold and silver mills and 16 tons to smelters. The yield in bullion from the ore treated at gold and silver mills was $59,927 in gold and 5,287 ounces of silver; from 3 tons of concentrates the yield was $82 in gold and 1,259 ounces of silver; and from the 16 tons sent to smelters it was $310 in gold and 1,124 ounces of silver. The two placer mines worked in 1920 yielded $868 in gold and 23 ounces of silver.

The Glen Olive mine and 10-stamp mill in the Pioneer district, near Bodfish, was operated throughout 1920. Only a small output was made by the Keyes, at Isabella. The Shipsey Mining Co., owners of the King Solomon mines, at Johannesburg, operated the mine and 5-stamp mill the entire year, and the Gold Coin, at the same place, returned a small output. There is a 20-ton cyanide and concentrating plant at the Cowboy, at Loraine, which was operated until October and was then closed. The Gwynne mine, with a Hardy mill, and the Jeannette, both at Caliente, produced some gold in 1920. The Baltic and Silver Bell, Butte, Merton Mining Co. (Buckboard), Erracart (silver mine), Minnehaha, Minnesota, and a few other small mines, at Randsburg, made a small production. At the Yellow Aster, formerly the largest producer in the southern part of California, no work was done in 1920, except to take care of the property and to mill a few tons of rich ore. The mine is equipped with a 100-stamp amalgamation mill. The Tropico Mining Co. (Antelope Valley, Hope No. 1, Tiger Head, Fairview, and Hamilton mines), at Rosamond, has a 10-stamp amalgamation mill and 30-ton cyanide plant, which were operated half time until April only, but development work was kept up the entire year. General development work was carried on at the Bertha mine, Caliente, and a new compressor house and assay office were erected.

Creek gravel was worked by dry washing by David Bowman in the Red Rock district, 5 miles from Cantil, where occasional prospecting is still being done. The May hydraulic mine was productive in a small way on Kelso Creek, near Weldon, but it was operated only two months, being dependent on snowfall for water in the streams.

MADERA COUNTY.

Madera County had only six active mines that reported production in 1920—two deep gold mines, three copper mines, and one surface placer. The total value of all metals in 1920 was $24,371, or $16,301 less than in 1919. The 1,142 tons of ore treated yielded $6,139 in gold, $1,481 in silver, and 89,678 pounds of copper, valued at $16,501.

The Kroromick (old Texas Flat) mines, at Coarsegold, equipped with a 20-stamp amalgamating and concentrating mill, produced some gold. Some copper ore was shipped to smelters at Tacoma, Wash., from the Buchanan mine, near Raymond, by lessees of the U. S. Smelting & Refining Co., which owns the property. Small shipments of copper ore were also made from the Zerze mine, near the same place. At the Apex copper mine, Chowchilla, a 25-ton Gibson mill and flotation plant was installed in 1920, together with surface appliances, but no ore was treated.

A little placer gold was obtained by Indians and prospectors around Coarsegold.

MARIPOSA COUNTY.

Mariposa, one of the Mother Lode counties of California, made a total metallic output valued at $266,535 in 1920, or $9,004 more than in 1919. Of the 23 mines reporting production 22 were deep gold mines, which produced $261,430 in gold and $4,702 in silver. One surface placer produced $400 in gold and $3 in silver.

The deep mines of the county produced 28,659 tons of siliceous ore, all of which was milled and yielded $228,942 in gold and 2,737 ounces

of silver in bullion. From this ore was derived 443 tons of concentrates, yielding $32,488 in gold and 1,577 ounces of silver.

Gold was obtained by hand mortar and pan from the Jumper pocket mine and other small operations around Bagby. The Original Mining & Milling Co., at Clearinghouse, made the largest output in Mariposa County, operating both mine and 20-stamp mill the entire year and doing about 600 feet of development work. Lessees worked the Marble Springs mine, near Coulterville, for a short time, and Cuneo Bros. also obtained some gold. The operators of the Texas Hill mine also shipped gold ore, but their operations were suspended during the construction of a new 20-stamp mill and the installation of water power. The White Gulch Mining Co. (Virginia mine) worked its mine and mill the entire year. This property is equipped with a 10-stamp mill, Hardinge mill, and two concentrators. At the Ruth Pierce and Grimshew, Hornitos, some 650 feet of drifting was done in 1920 and a large output was made. The mine has a 10-stamp mill and two Frue concentrators. There were very few small operators producing near Hornitos and Mariposa in 1920. Small operators near Jerseydale were the Early, Dominion, and Puzzle; ore from the Puzzle was worked in a hand mortar and panned. All the mines of the Mariposa Commercial & Mining Co., Mount Bullion, continued idle, although a few thousand dollars in gold was obtained by pocket hunters and from mill clean-ups. The Mountain King Mining Co. operated its mine 12 months and its 30-stamp mill 11 months in 1920. This mine is developed from a 2,470-foot tunnel on the 1,000-foot level and an inclined shaft from this tunnel to the 2,000-foot level. The work in 1920 consisted of sinking 150 feet and drifting 1,014 feet. The new highway to the Yosemite Valley will pass through the old Fremont or Mariposa grant and will benefit a number of the mines in the county.

MONO COUNTY.

The total value of the metal output in Mono County increased from $86,159 in 1919 to $186,791 in 1920. The gold alone increased from $29,428 to $144,746. In 1919 the yield of silver was 49,605 fine ounces and in 1920 it was 31,531 ounces. The output of copper increased from 2,425 pounds to 4,701 pounds, valued at $865. The output of lead increased from 13,617 pounds to 85,144 pounds.

The crude ore treated at gold and silver mills amounted to 2,675 tons, which yielded $13,501 in gold and $14,019 in silver, no concentrates being reported. The ore sent to smelters was 700 tons, yielding $131,245 in gold, $20,350 in silver, and all the copper and lead produced.

The ore mined from the Blind Spring Hill, at Benton, containing lead, silver, gold, and copper, was shipped to the Midvale smelter, Salt Lake City, as was that from the Silver Reef mine and the Powell Leasing Co., at the same place. M. S. Kirkwood shipped a little ore from Bodie to the Selby smelter, but most of the gold from that old camp came from lessees on the Standard mine, formerly one of the large producers of the State. The Golden Gate mine and 10-stamp mill, at Colville, formerly owned by the Mono Mines Co., became the property of the Diamond Peak Development Co. in 1920, and considerable retimbering was done in the mine.

A small lot of silver ore was shipped from the Dark Horse, at Masonic, and some gold came from the Decker lease on the Chemung mine. The largest single output in Mono County in 1920 was made by the Kibble-Cook Leasing Co., which leases the Chemung mine from the Masonic Mines Association, paying a royalty on shipping ore. The property was worked the entire year and the ore was shipped to smelters, but a mill is to be erected. Considerable gold and silver were recovered from dump ore at the property of the Nevada Progressive Gold Mining Co., at Masonic, which is to be equipped with a 150-ton mill.

NEVADA COUNTY.

Nevada County was second in rank among the gold-producing counties of California in 1920 and first in the production of gold from deep mines. Only 20 mines reported production, of which 14 were deep mines, and one of these had the largest output of gold of all the quartz mines in the State. There were 3 hydraulic, 1 drift, and 2 surface placers. The total value of the output of metals from Nevada County was $2,930,947, of which $2,872,471 was in gold, and $58,476 in silver. As compared with 1919, there was a decrease of $108,841 in gold and $10,255 in silver. Some copper and lead were produced in 1919, but none were reported in 1920.

The deep mines produced $2,860,557 in gold in 1920, or $93,226 less than in 1919, and the yield of placer gold was $11,914, or $15,615 less. The value of the output of silver from deep mines was $10,103 less than in 1919 and that from placers $152 less.

The total quantity of ore produced in 1920 was 264,613 tons, or 51,431 tons less than in 1919. This ore yielded $2,860,557 in gold, or $10.81 a ton, and $58,388 in silver, or $0.22 a ton, a total value of $11.03 a ton. The average value of the ore in gold and silver in 1919 was $9.56 a ton and in 1918 it was $8.85 a ton. Considerable ore was sorted before milling at certain large mines in 1920, which accounts for the higher average value.

Gold and silver mills in Nevada County treated 264,604 tons of ore, recovering $2,847,712 in gold and $58,043 in silver as bullion. Only 62 tons of concentrates were shipped or treated separately and carried $10,943 in gold and $317 in silver. In explanation of this apparent anomaly it may be stated that by modern practice in milling in the county, after the ore is crushed under the stamps and the sulphurets are concentrated the concentrates are reground in a tube mill and added to the tailings and the whole is cyanided, the operation being continuous. The former method of separating the concentrates and shipping them to a smelter for reduction is not followed, except to a small extent. The reports received from the chief producers do not now give separate quantities and values of the concentrates, as they did when the sulphurets were saved and shipped for separate treatment. Nine tons of ore was shipped to smelters for reduction, and yielded $1,902 in gold and $28 in silver.

Grass Valley is the principal center of mining operations in Nevada County and the most productive deep-mining camp in the State, but the number of productive mines at this place has been much reduced during the last few years, and the companies still working have been compelled to curtail operations materially and would close down for the present were it possible to do so without great loss and damage

to the mines. The Alcalde or Kenosha mine, at Grass Valley, did some shaft sinking and about 1,400 feet of drifting in 1920 and added 5 stamps to its old 5-stamp mill. Some winzes opened the new ore body picked up in the drift at the 400-foot level. The Empire Mines, which includes the Pennsylvania, made the largest output of gold in the county. Material changes and improvements in the milling plant of this property were made in 1920. The old Allison Ranch mine, incorporated under the name of the Grass Valley Consolidated Gold Mines, which is opened by an inclined shaft 1,625 feet deep, cut more than 2,600 feet of drift while prospecting and milled some ore. The work done has consisted in reopening the old mines, but operations were suspended after the end of the year. At the North Star Mines the reduction plant was operated continuously during 1920 at half capacity. The mine is equipped with a 60-stamp mill and 350-ton cyanide plant; 7,285 feet of development work was done during 1920. A total of 79,325 tons of rock was delivered to the sorting plant, of which 17,925 tons was discarded as waste, leaving 61,400 tons to be crushed, with an average yield of $11.70 a ton at an average cost of $8.31 for operating and $2.20 for development, an aggregate cost of $10.51 per ton crushed ($8.11 per ton mined), leaving a realized profit of $1.19 per ton crushed. The gross yield per ton crushed was $2.75 more in 1920 than in 1919. The total cost per ton of operation and development in 1920 was $10.51, as compared with $7.81 in 1919. The increased yield per ton in 1920 was due to more selective mining and a presumably higher grade of ore mined during the last eight months of the year; and the higher cost per ton may be ascribed to an increased wage rate after July 1, a decreased tonnage, and an outlay for development work more than double that of the previous year. The fairly successful results obtained during the last eight months of 1920 were due to the higher grade of ore crushed and to somewhat greater labor efficiency, rather than to any general reduction in the cost of labor and supplies. The gross production of the mine from 61,400 tons of ore milled in 1920 was $718,286. Of this amount 80.61 per cent was obtained in the mill by amalgamation, and 19.39 per cent was recovered by cyanidation. It is estimated that the value of the metals lost in the tailings was about 32 cents per ton of ore crushed. From May, 1884, to the end of 1920 this mine has produced 2,125,310 tons of ore, yielding $23,782,509, or $11.19 a ton. The operating and development expenses have been $16,576,178 ($7.80 a ton), and the profit has been $7,206,331 ($3.39 a ton). Dividends aggregating $5,612,040 have been paid. The Sultana Gold Mining Co., which is opened by an inclined shaft 2,100 feet deep, is equipped with a 20-stamp mill and continued production during 1920. As Grass Valley is the largest and most central place in Nevada County, a great deal of gold is brought there in small lots every year from outlying camps and districts by prospectors, lessees, small miners, and others and is purchased by banks, gold-dust buyers, assayers, and merchants. The larger companies have direct systems of shipping gold, and thus their output is readily distinguished, but it is impossible to assign to any particular mine the small lots purchased in this county, which aggregate a large sum during the year. Doubtless more or less of this gold has been "high-graded," as the owners of the larger mines have always claimed, but it is impossible to detect individual

cases by any method so far put into effect. In the statistics of this chapter this gold has been credited to the county's total output as from "small mines," and every care has been taken to avoid duplication.

In Nevada City small yields were reported from the Bovee and Mountaineer mines and from various individuals. A great deal of "small-mines" gold is purchased annually in this town, as well as in Grass Valley. The most productive property in Nevada City in 1920 was the Champion mines, owned by the North Star Mines of Grass Valley. The Champion is equipped with a 40-stamp mill and 100-ton cyanide plant, and 20 of the stamps ran only six months. The properties of the Champion mines, long idle, were purchased and reopened in 1911 by the North Star Mines, and since that time 291,336 tons of rock has been milled, yielding $1,609,516, or $5.52 a ton, at an aggregate cost for operation and development of $2,215,474, or $7.61 a ton. Nearly all the rock crushed came from the 2,400 and 3,000 foot levels of the Providence mine, the extraction of which virtually exhausted the only developed ore body in the mines. This has been a losing investment for the North Star Mines, so in June, 1920, the plant and mines of the Champion were closed permanently.

The California Placer Mines Co. (You Bet mines) and the Liberty Hill mine, in the Bear River basin near Dutch Flat, took out a little gold by hydraulic methods. The Quaker Hill Gold Mines Co., at Nevada City, is mining Tertiary gravels containing gold. The mine is opened by an adit 1,200 feet long, and in 1920 some 2,500 feet of drifts and crosscuts were run in the gravel bed. The gravel mined is washed in a 200-ton gravel mill, the pebbles are discharged, and the fines are run over amalgamating plates. The mill was operated only about three months during development work. No reports were received from any "going" mines in the formerly productive camps in districts such as Graniteville, North Bloomfield, North Columbia, North San Juan, Relief, Rough and Ready, Spenceville, or Washington. All the mines in those places remained idle, although some of the old mills were utilized on chrome ores during the World War.

PLACER COUNTY.

The total value of metals produced in Placer County in 1920 was $153,266, $151,088 in gold and $2,178 in silver—a decrease in total value, as compared with 1919, of $21,539. Of the 32 mines reporting production, 10 were deep gold mines, 3 hydraulic mines, 1 dredge, 9 drift mines, and 9 surface placers. The production of gold from deep mines in 1920 was $66,403 and from placer mines $84,685, a decrease in the total of $19,521 compared with 1919. Deep mines in 1920 produced 1,525 fine ounces of silver and placer mines 473 ounces, a total of 1,998 ounces, valued at $2,178, or a decrease of $963.

There was 10,343 tons of ore mined in Placer County, all siliceous, of which 10,338 tons went to gold and silver mills. Of the gold and silver recovered in milling, $61,069 in gold and $1,012 in silver were saved as bullion and $5,127 in gold and $490 in silver were recovered from the 82 tons of concentrates produced. Five tons of ore were shipped to a smelter and yielded $207 in gold and $161 in silver.

Of the gold won by placers, $2,308 came from hydraulic mines, $7,285 from drift mines, $3,144 from surface placers, and the rest from dredging operations.

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The Oro Fino Mining Co., Auburn, operated its plant only one shift a day in 1920, although occasionally the 10-stamp amalgamation and concentration mill was run two shifts. Little development work was done during the year. A small quantity of ore was produced by William Schindler at his mine 7 miles east of Auburn, and some gold was produced at the Rising Sun mine at Colfax. Small quantities of gold were obtained from the Dry Hill & Blue Jay Consolidated, Johnny Rafael, and Snow Bird, in the Forest Hill section. The Pioneer Gold Mines Co., at Towle, did very little work in 1920, though a small output was made.

The Pacific Gold Dredge Co. operated one dredge for nine months on American River 3 miles from Applegate. Very little gold came from five months' work on the Haub drift mine, at Blue Canyon, but considerable gold was won by panning or sluicing by J. Schillinger on Bear River and gulches 7 miles from Colfax. The producing drift mines at Michigan Bluff were the Albonos, Bigelow, Glenn, and Last Chance; and a little placer gold was obtained at Towle, Yankee Jim, Gold Run, Dutch Flat, Forest Hill, and Iowa Hill.

PLUMAS COUNTY.

The total value of all metals produced in Plumas County in 1920 was $2,017,025, or $262,360 less than in 1919. The production of 1920 was distributed as follows: Gold, 4,938.94 fine ounces; silver, 139,792 fine ounces; copper, 9,579,105 pounds. Twelve deep mines produced $86,423 in gold, 139,688 fine ounces of silver, and copper valued at $1,762,555, a total value from the deep mines of $2,001,238. The six hydraulic mines yielded $8,376 in gold, five drift mines $5,886 and five surface placers $1,412, a total of $15,674, or $828 less than in 1919. The placer silver was valued at $113. The output of copper in 1920 was 9,579,105 pounds, as compared with 10,859,885 pounds in 1919.

In 1920 the ore treated was 289,856 tons, as compared with 328,431 tons in 1919. It comprised 282,004 tons of copper ore and 7,852 tons of siliceous ore. The siliceous ore carried $59,767 in gold and $549 in silver, a total of $60,316, or an average of $7.68 a ton. The copper ore had a total value of $1,940,922, or an average of $6.88 a ton. All the siliceous ore was treated at gold and silver mills. Of the copper ore 281,994 tons was treated by flotation concentration and yielded 16,750 tons of concentrates. The 10 tons of copper ore sent to a smelter yielded $21 in gold, 341 ounces of silver, and 1,699 pounds of copper.

The Engels Copper Mining Co., at Engelmine, was by far the largest producer in the county, as it is the largest copper producer in the State. Nearly 9,000 feet of development work was done during 1920 and operations were continuous. The company has a 1,200-ton oil flotation plant, the concentrates from which are sold to the Garfield Smelting Co., Garfield, Utah. The Ruby Mining Co., near Engelmine, has a 5-stamp wet concentrating mill, and shipped the copper concentrates to Garfield. A small output of gold was made by the Long Valley Mining Co. at Greenville, where it has a 5-stamp mill. Sobrero & Co., lessees on the old Jamison mine, at Johnsville, obtained considerable gold in stoping and ran some development drifts. Only about two months' active operation was carried on by the Plumas-

Eureka Corporation, at Johnsville. The property is equipped with a 20-stamp mill. The Walker Mining Co., at Spring Garden, equipped with a flotation plant of 200 to 225 tons capacity is the second largest copper producer in the county. It has an adit 4,900 feet long and a 225-foot shaft. In 1920 the adit was completed and much drifting done in the mine. The mine and mill were closed October 25, and arrangements were made for consolidating the mine and mill camps at the mill camp; all operations will be conducted through the adit instead of by aerial tram from the mine. The concentrates from the flotation plant are shipped to the International Smelting Co., Tooele, Utah. The Apex mine, at Quincy, made some production, using its 6-ton Gibson mill for amalgamation. A small output of gold was also made by the Crown Point group and Oversight mines, at the same place. The White Lily mine of the Seneca Consolidated Mining Co., at Seneca, had a good production. The Trask & Coffer Mining Co. operated the Beetle, Beetle Extension, and Moonlight copper mines, at Paxton, and shipped the concentrates to the Garfield smelter. The ore is crushed in a 5-stamp concentrating mill, with table and vanners.

No extensive placer-mining operations have been carried on in Plumas County for several years, but there are a number of small producers. In 1920 these were the small mines near Blairsden and Greenville; Lincoln, Continental, and Nelson Creek at Johnsville; Wood Estate Co. (Little Grass Valley, Quigley, and Sweet Oil Diggings); Smith Fork Mining Co. and other small mines, at La Porte; Butte Bar drift, Mount Ararat hydraulic, and Little Annie sluicing, at Meadow Valley; Grizzly Creek hydraulic, at Portola; Yankee Bar, at Seneca; and Jenkins and Twelvemile Bar drift, at Twain.

SACRAMENTO COUNTY.

Sacramento was fourth in rank among California gold-producing counties in 1920, entirely by reason of the activities in the dredging industry. The total gold output of the county was $1,575,033, or $139,160 less than in 1919. All the gold except $289 was derived from dredging operations in the vicinity of Folsom. The Natomas Co. of California operated eight dredges at Natomas, in the American River field. The Indiana Dredging Co., at Michigan Bluff, ceased operations and the corporation was dissolved December 29, 1919, but a little "clean-up" yield was obtained in 1920. Considerable platinum was also recovered in these gold-dredging operations. Only one deep mine was worked in the county in 1920, and its gold output was nominal.

SAN BERNARDINO COUNTY.

The total value of the metals produced in San Bernardino County from the 19 deep gold and silver mines and 4 lead mines reporting output in 1920 was $1,298,261, or $778,186 more than in 1919. This is a larger increase than that of any other county in the State and places San Bernardino among the counties of California producing more than a million dollars annually. It was due wholly to the operations of the California Rand Silver (Inc.), the largest silver mine of the State, which was first productive in 1919. The increase in value of silver alone in San Bernardino County in 1920, as com-

pared with 1919, was $785,270. There was also a gain of $39,426 in gold, but the value of the copper decreased $46,677, and there was only a nominal increase in the value of the lead. Deep mines yielded $79,195 in gold, 1,112,832 fine ounces of silver, valued at $1,212,987, 1,080 pounds of copper, valued at $199, and 73,495 pounds of lead, valued at $5,880.

Of the 3,831.06 fine ounces of gold produced, 3,809.10 ounces was obtained from siliceous ores, and 21.96 fine ounces from lead ores. The silver derived from siliceous ores amounted to 1,098,903 fine ounces, and that from lead ores to 13,929 fine ounces. The small quantity of copper produced came from lead ores.

The ore from San Bernardino County treated in 1920 was 30,678 tons, of which 29,663 tons was siliceous ore and 1,015 tons lead ore. Of the siliceous ore, 28,211 tons came from 18 silver mines and yielded $1,196,304 in silver, $72,965 in gold, and $422 in lead.

There are many more silver mines in San Bernardino County than in any other county of the State, and most of them are old mines reopened in the last few years after long idleness. Four lead mines produced 1,015 tons of ore which yielded 53,078 pounds of lead, 13,929 fine ounces of silver, and 21.96 fine ounces of gold.

Gold and silver mills treated 1,381 tons of ore, yielding $21 in gold and $1,372 in silver as bullion; and 920 tons of ore was sent to concentrating mills and produced 99 tons of concentrates, from which was recovered $496 in gold, $15,628 in silver, and 14,338 pounds of lead. Smelters received 12,042 tons of ore, which yielded $78,678 in gold, 1,074,760 fine ounces of silver, 1,080 pounds of copper, and 55,163 pounds of lead. The 16,335 tons of old tailings treated in the county yielded 22,475 ounces of silver but no gold.

The Bagdad-Chase Gold Mining Co., at Barstow, shipped considerable ore containing gold, silver, and lead to the smelters but did not use the 30-ton cyanide plant, which was finally dismantled at the end of 1920. Gimmell Bros. shipped silver ore from the same camp. Lead-silver ore was shipped from the Ivanpah, at Cima, but the mine was not worked. The Cima Commercial Trust (New Harmony and old Death Valley mines) shipped lead ore carrying considerable silver to the Garfield and Murray smelters, Utah. The property has a 50-ton wet concentration plant. The Dutch Silver (formerly Swastika mine) was operated about five months and shipped lead-silver ore to Salt Lake smelters. The Daggett Reduction & Mining Co. worked several thousand tons of silver-bearing tailings from the old Calico mines. Other shipments of silver ore from the same district were made by the Parry, Ryerson, Sioux, King, Red Jacket, Alf, and Waterloo mines, most of it mined by lessees. A small quantity of silver ore was also shipped from the Riviera mine, at Danby. The producing mines at Goffs were the Bonanza King and Perseverance; the Juanita was the only producer at Ivanpah. The California Rand Silver (Inc.), or Kelly mine, in San Bernardino County, just over the Kern County border, near Johannesburg, is the most productive silver mine in the State. The ore, which carries considerable gold, is shipped to the Selby smelter on San Francisco Bay. The mine is developed by an inclined shaft 622 feet deep and 7,000 feet of crosscuts and drifts, of which 4,500 feet were cut in 1920. The mine was operated throughout the year. The Acasta mine, in the same vicinity, shipped a small lot of silver ore, and lessees on the

California Rand Silver shipped considerable ore in addition to company shipments. Small lots of silver ore were shipped from Silver Lake by the Artie No. 2 (surface pockets), Bird, Alta, and Artie mines. The Sterling shipped a little silver ore to Salt Lake smelters from Trona.

SHASTA COUNTY.

The total value of all metals produced in Shasta County in 1920 was $470,607, or $1,497,738 less than in 1919, a greater decrease than in any other county in the State. The output was as follows: Gold, $312,901; silver, 33,544 ounces, valued at $36,563; copper, 513,620 pounds, valued at $94,506; lead, 31,745 pounds, valued at $2,540; and zinc, 297,500 pounds, valued at $24,097. Compared with 1919, the decrease for 1920 in gold was $65,382; silver, $129,239; copper, 7,112,038 pounds in quantity and $1,323,866 in value. Zinc increased 216,842 pounds in quantity and $18,209 in value in 1920, and lead increased 31,745 pounds and $2,540. The total value of all metals in this county in 1918 was $7,462,642 and in 1919 $1,968,345. This large decrease in the output was due to the closing of the great copper smelters of the county, which produced large quantities of copper and other metals. In 1920 26 mines reported production from the county, 15 deep gold mines, 2 copper mines, 1 lead mine, 4 dredges, and 4 surface placers.

The deep mines in Shasta County produced $13,998 in gold, and the placer mines $298,903, a decrease in gold from deep mines, as compared with 1919, of $73,729 and an increase of $8,347 in gold from placers. Of the gold produced from deep mines, 533 ounces came from siliceous ores, 139 ounces from copper ores, and 5 ounces from lead ores.

The output of silver from mines was 33,544 fine ounces, of which 31,935 ounces came from deep mines and 1,609 ounces from placers. The 1,457 tons of siliceous ore yielded $11,021 in gold and 1,572 ounces of silver. The 6,088 tons of copper ore yielded $2,874 in gold, 29,485 ounces of silver, 510,253 pounds of copper, and 297,500 pounds of zinc. The 120 tons of lead ore yielded $103 in gold, 878 ounces of silver, 3,367 pounds of copper, and 31,745 pounds of lead.

The ore from Shasta County mines treated in 1920 amounted to 7,665 tons, of which 1,457 tons was dry or siliceous ore, 6,088 tons copper ore, and 120 tons lead ore. Gold and silver mills treated 1,454 tons of dry or siliceous ore, from which was recovered $10,297 in gold and $636 in silver. From 4,000 tons of copper ore and 1,063 tons of siliceous ore 2,511 tons of concentrates were obtained, carrying $889 in gold, $3,072 in silver, 27,960 pounds of copper, and 297,500 pounds of zinc. There was 2,211 tons of ore sent direct to smelters, which carried $2,812 in gold, 28,533 ounces of silver, 485,660 pounds of copper, and 31,745 pounds of lead.

The four dredges of Shasta County produced gold valued at $297,488, and the four sluicing properties $1,415 in gold in 1920, as compared with $290,008 from five dredges and $548 from three surface mines in 1919.

Some gold was obtained in 1920 by lessees of the El Dorado & Eureka group and of the Emma mine of the Five Pines group at French Gulch. Small sums of gold were produced at the Montgomery and Sheriff mines, at French Gulch, and the Hope and Kingsbury mines, at Igo, were small producers. The Afterthought

Copper Co., at Ingot, closed its mine the last of February, after making some shipments of copper and zinc ore. This mine is equipped with a 300-ton reverberatory furnace and a 250-ton flotation mill. The product consisted of zinc concentrates and copper concentrates. The copper concentrates were smelted to copper matte, which was shipped to the Tacoma smelter, and the zinc concentrates were shipped to the Kusa smelter, Okla. The property has remained closed since the end of February, 1920. The Mammoth mine and plant of the United States Smelting, Refining & Mining Co. remained closed all the year, but some small shipments of lead-silver ore were made to Utah smelters. The Victor Power & Mining Co., at Knob, did considerable development work in 1920 and built a new milling plant, consisting of four Gibson mills, with a capacity of 100 tons a day. A little gold came from the Korte pocket mine, at Centerville, and the McDaniel pocket and Sugar Loaf mines, at Redding. The Yankee John Development Co., near Redding, operated its mine until September, 1920, and its mill for five months. During the year a new hoist, mill engine, and water-supply equipment were installed. Some mines were worked productively in a small way around Redding, Schilling, and Taylor. The Shasta Zinc & Copper Co. now owns the Bully Hill, Rising Star, and Baxter mines, at Winthrop, and has a 200-ton zinc oxide plant. Operations at the Balaklala mine have been suspended since 1919.

The Shasta Dredging Co. operated at Gas Point in 1920; L. Gardella operated two dredges on Clear Creek, near Redding; and one dredge was operated by the American Gold Dredging Co., near Redding. Some gold came from small placers at Gas Point, Lamoine, and Redding.

SIERRA COUNTY.

The 8 placer mines and 11 deep gold mines of Sierra County that made returns in 1920 produced gold and silver valued at $446,861—$442,894 in gold and $3,967 in silver. This was a total increase of $142,732, as compared with 1919, the gold increasing $141,722 and the silver $1,010. Of the gold the deep mines produced $417,594 and the placer mines $25,300; of the silver the deep mines produced $3,865 and the placers $102.

All the ore treated in Sierra County in 1920, 19,989 tons, was siliceous and was handled exclusively by gold and silver mills, the metals being recovered as bullion; no concentrates were produced. Of the placers 2 hydraulic mines produced $19,487 in gold and 6 drift mines $5,813.

The Alleghany Mines Co. (Tightner), at Alleghany, worked the mine the entire year but the 20-stamp mill ran only after May. Some 2,600 feet of development work was done. The Eldorado Wisconsin Co. did 1,450 feet of development work and operated the mine the entire year, but the water-power mill was operated only 8 months, depending on the water supply. The Durston Gold Mining Co. (Irelan mine) made considerable production; it has a 10-stamp amalgamation mill. The Mariposa Mine Association (Ophir mine) made some output. At the Original 16 to 1 mine, which now includes the former Twenty-one mine, over 1,100 feet of development work was done and the 10-stamp mill was kept running. A little gold came from the Willoughby mine, at Downieville. The Four Hill Mining Co. did some prospecting for high-

grade ore only and ran its 20-stamp mill intermittently. Development was carried on in the Monarch mine, Sierra City, until August, when the mine and 20-stamp mill were closed. Little output was made by the Primrose Gold Mining Co., which has a 5-stamp amalgamation mill. The Kate Hardy mine, at Forest, made no output in 1920 but started building a new 10-stamp mill. The big Sierra Buttes mine and mill at Sierra City were also idle.

The only important placers in the county were the hydraulic mines of the Yuba Development Co., at Brandy City, and the Depot Hill, at Camptonville. The producing drift mines were the Pleasant View, at Camptonville; the Coincident, at Downieville; the Neversweat, West Point and Wakoo (near La Porte, Plumas County); the Mount Alta, at Pike; and the Table Rock, at Table Rock.

SISKIYOU COUNTY.

Forty-two mines operated in Siskiyou County in 1920, or 21 less than in 1919, yet the county, as usual, led all other counties of the State in number of active producing mines. There were 20 hydraulic mines, 2 dredges, 4 drift mines, 4 surface placers, 11 deep gold mines, and 1 copper mine. The total value of the output of the county in 1920 was $121,867, distributed as follows: Gold, $80,707; silver, $5,218; copper (195,339 pounds), $35,942. The total value was $238,785 less than in 1919, the decrease in gold being $145,818, in silver $11,831, and in copper $81,136.

Of the gold output the 12 deep mines produced $7,422 and the placers $73,285. Of the placer gold $19,508 came from 20 hydraulic mines, $1,289 from 4 sluicing mines, $664 from 4 drift mines, and $51,824 from 2 dredges. The dredges worked only part of the year, when they were both closed permanently, the available ground being worked out.

Of the silver output of the county deep mines yielded 4,249 ounces and placer mines 538 ounces. The dry ores yielded 227 ounces and the copper ores 4,022 ounces.

The 736 tons of copper ore smelted contained $1,736 in gold, $4,384 silver, and 195,339 pounds of copper. There were only 242 tons of ore milled, which yielded $4,776 in gold and $65 in silver.

A little ore was taken out of the old Black Bear mine, at Black Bear, by watchmen, and a little ore from the Firebug & Scatterment mine was worked in an arrastre. The Mexican Smelting & Refining Co. worked the Blue Ledge copper mine, at Copper, for nine months and then closed it. The ore was sold to the Tacoma smelter. Small outputs were made from the Richardson pocket, at Hornbrook, Snow Flake and Little Gem, at Rollin; Merriam, at Sawyers Bar; Scott Bar, at Scott Bar; Homestake, at Etna Mills; Goodhue, at Yreka; and Cory & Johnson, at Callahan. The Klamath Mining & Exploration Co. (Hoboken mine), at Yreka, did development work in 1920 and erected a 3-stamp amalgamation mill.

The placer mines of Siskiyou County are numerous, but many of them were idle in 1920. The Banner, Carter, and a few other claims near Black Bear and the Sugar Hill and some others at Callahan were producers in a small way. At Cecilville the producers were the Big Bend, Irwin, Jefferson Consolidated, and Summerville. Small operators made gold shipments from Cecilville, Etna Mills, Forks of Salmon, Fort Jones, Scott Valley, Hamburg, Hornbrook, and Sawyers

Bar. The Siskiyou Dredging Co., near Fort Jones, ceased operations permanently April 1, 1920, having worked out its available ground. The producers at Happy Camp were the Crompton and Huey Hill hydraulic mines; at Sawyers Bar, the Frazier, Paddy Cronin, Forks of Salmon River, Meyer, and some smaller ones. The Enterprise and Rocky Point were small producers at Scott Bar, as was the Barkhouse Creek at Walker. El Oro Dredging Co., near Yreka, worked about three months and then dismantled its dredge and abandoned the property, taking the machinery to Butte County to work on ground there.

TRINITY COUNTY.

The 19 placers and 8 deep mines of Trinity County in 1920 produced metals having a total value of $544,856, or $2,644 less than in 1919, consisting of $541,387 in gold, and $3,469 in silver. No copper was produced in 1920.

Of the gold deep mines produced $19,805 and placers $521,582. The output of placers came from 4 dredges, $513,976; 10 hydraulic mines, $6,490; 3 drift mines, $718; and 2 sluicing mines, $398. Of the silver output the deep mines produced $268 and the placers $3,201.

The ore treated amounted to 1,695 tons, all siliceous. The 1,692 tons milled yielded $19,102 in gold and $256 in silver. The other 3 tons was shipped to a smelter and produced $703 in gold and $12 in silver.

A small quantity of gold was obtained from the Packer group at Coffee Creek, and from the Black Bess, at Hayfork. The producers at Lewiston were the Donnelly Gulch Mining Co. (Henry Clay mine), Gold Hill group (Wood Rat mine), and C. P. Richards. The Fairview mine and 10-stamp mill, at Minersville, were worked under lease by the Dunsmuir Gold Mining Co. The Globe and Chloride & Bailey mines, at Dedrick, were operated by Bulkeley Wells and associates until November, when the plant was completely closed. This property is equipped with a 20-stamp all-sliming cyanide mill, but it was worked for only three months in 1920. The Mountain Boomer, at Denny, New River district, made a nominal output.

Fewer placer mines than usual were productive in Trinity County in 1920. The Pacific Gold Dredge of the Yukon Gold Co. operated 10 months near Carville. At Coffee the Underground Treasure and Nugget worked for 60 days. At Denny the McAtee Bar hydraulic worked 25 days, the Eagle Bird 60 days, and the Log Cabin, McEvers, and Staley were small producers, as were the Coombs and Smith mines at Hayfork. At Junction City the only important producer was the Valdor Dredge Co., which operated the entire year. The hydraulic mines of the Bablew Mines Co. (Inc.) were worked 155 days. The Trinity Dredging Co. made a large production at Lewiston, as did the dredge of the Estabrook Gold Dredging Co., at Trinity Center, although work was carried on for only nine months. At Weaverville the only productive placers were the Kincaid and Arbuckle hydraulic mines and a few smaller ones.

TUOLUMNE COUNTY.

In Tuolumne County 20 deep mines produced 56,541 tons of ore, which yielded $254,569 in gold and $6,007 in silver, a total of $260,576, or $221,521 less than in 1919.

Of the ore produced 35,442 tons was treated at gold and silver mills and yielded as bullion $150,089 in gold and $5,126 in silver. Concentrates from this ore and from 20,309 tons treated in concentration mills alone amounted to 6,434 tons, from which was obtained $95,819 in gold and $785 in silver. The recovery from tailings (790 tons) was $8,661 in gold and $96 in silver.

Tuolumne is one of the Mother Lode counties of California, but few of the older properties on the lode are being worked on any extensive scale. At Big Oak Flat the only mines reporting production were the Eureka, McCreedy pocket, and Mastodon and Silken pocket. The Eureka has a 1-stamp mill, but the rich ore from the others is worked in hand mortars. The Mountain Lily pocket mine, at Columbia, was worked by lessees, who used a hand mortar and pestle, though there is a 5-stamp mill on the claim. The Over and Podesta are both pocket mines. The Experimental Gulch was operated only about eight months, when the 3-stamp mill near the shaft was used. The Clio-Vindicator Mines (Inc.), at Jacksonville, worked its mine the full year, but the mill only intermittently after July 15. The old 10-stamp mill is not efficient and is to be replaced by a larger reduction plant. Prospecting was done at the McCormick, which is equipped with a No. 2 Denver mill and crusher. The Carlin pocket mine was a small producer at Jamestown. The Pacific Coast Gold Mines Corporation, at Quartz, owns the App, Dutch, and Sweeney mines, old and well-developed properties. There are two inclined shafts, one 2,300 feet and the other 1,300 feet deep, and some 30,000 feet of drifts and raises. The ore worked in 1920 was crushed in a gyratory crusher, ground in ball mills, amalgamated on plates, and concentrated by oil flotation and tables. The reduction plant has a capacity of 300 tons of ore daily. The mine and mill were operated for three months in 1920 but were closed April 15. The Belmont-Shawmut Mining Co. (formerly Eagle-Shawmut), at Shawmut, made a large output in 1920, although it was operated only until August 3. The reduction plant consists of a 70-stamp concentration mill and a 25-ton cyanide plant for the treatment of concentrates. The ore is treated by gravity concentration after roasting. This is a well-developed property with three inclined shafts, one 420 feet, one 720 feet, and one 2,991 feet deep, and an adit 1,060 feet long; the aggregate of raises and winzes is 11,584 feet; of crosscuts, 4,400 feet; and of drifts, 31,929 feet. About 1,000 feet of underground development work was done in 1920. At Sonora some productive pocket mining was done in a small way on the Hope, Lincoln, and Shaw claims. The Black Oak Mines & Mill Co., at Soulsbyville, recovered its gold by the cyanide process. The Grizzly mine was developed throughout the year, but there was only a small production. The reduction plant consists of a 20-stamp mill, two Hardinge mills, and a cyanide plant. The only producers at Tuttletown were the Jupiter Consolidated (McArdle pocket) and Norwegian (pocket) mines.

YUBA COUNTY.

As in 1919, Yuba County was again the leading county of California in production of gold in 1920, because of the extensive dredging operations along Yuba River.

The output of the county was $3,467,769 in placer gold and 15,139 ounces of placer silver, valued at $16,502, a total of $3,484,271 and

a decrease of $723,737, compared with 1919. The 10 dredges (2 less than in 1919) produced $3,456,452 in gold, or $729,474 less than in 1919, and 6 sluicing mines and 4 drift mines produced the rest of the gold. A nominal quantity of gold came from the Bright Star & Reeves placer, at Browns Valley. The Pacific Gold Dredging Co. (Yukon Gold Dredge Co.) operated a dredge 10 months on the Yuba River bed about 4 miles from Browns Valley. The Snowden Hill drift mine at Camptonville, the Pepper sluicing mine at Challenge, and the Archimedes, at Marysville, were productive. The Yuba Consolidated Goldfields operated 8 dredges the entire year on stream gravel and old tailings near Hammonton. The Marysville Dredging Co. operated a dredge the full year at Marigold. The Paddy Creek drift (Blue Point), School Boy drift, and sundry river miners produced some gold near Smartsville.

OTHER COUNTIES.

Alpine and Modoc.—Only one deep mine was operated for two months of 1920 in Alpine County, and there was only one active mine in Modoc County. Both these mines made nominal outputs and have since been closed.

Fresno, San Joaquin, and Stanislaus.—There were in Fresno County only one productive placer mine and two productive deep mines in 1920. The placer is that of the Granite Rock Gravel Co., at Friant; the deep mines are the Glory, at Grabner, which has a small mill, and the Contact, at Sanger, which is equipped with 10-stamp Straub mill. The total output of gold was $7,793 and the silver was 208 ounces. In San Joaquin County the American Gold Dredging Co. operated a dredge for four months in the San Joaquin County side of Mokelumne River. In Stanislaus the La Grange Gold Dredge Co. operated a dredge the entire year on Tuolumne River, at La Grange, and the Yankee Hill Gold Dredging Co. worked a dredge for six weeks only near Knights Ferry, on Stanislaus River.

Humboldt.—The Forest Hill, at Orleans, was the only productive deep mine in Humboldt County in 1920. A 10-ton Gibson mill was installed during the year, but it was in operation only a few days. The placers operated were the Croton Bar, Golden Eagle, Orcutt, and a few smaller hydraulic mines, at Orleans; and the Klamath River Mining Co.'s surface placer, at Weitchpec. The value of the output of gold in the county in 1920 was only $2,538 and that of silver was $19.

Imperial, Los Angeles, and Orange.—There were only two productive mines in Imperial County in 1920, both deep mines—the Anaheim Mining & Milling Co., and the Paymaster, at Glamis. The Paymaster, which is equipped with a 25-ton cyanide plant, worked only a few weeks. The only mine reporting an output from Los Angeles County was the Big Chief, near Antelope Valley, the ore from which is ground in a Herman ball mill erected in 1920, and is amalgamated on plates. In Orange County the El Toro mine, at El Toro, was worked a few months, and the Blue Lights Mines Co., at Orange, was the only other producing mine. Both of these are deep mines.

GOLD, SILVER, AND COPPER IN OREGON.

(MINES REPORT.)

By Charles G. Yale.[1]

INTRODUCTION.

The same complaints come from Oregon miners as from those in other Western States as to the adverse conditions under which mining was carried on in 1920. Some of the larger properties have been idle altogether or have curtailed operations, and very few new enterprises have been started; but the downward trend of production in the State, apparent for several years, appeared to have been checked, as the production of metals for 1920 has increased, not very largely, but enough to show an encouraging favorable change in conditions.

Of the 67 mines that reported production in Oregon in 1920, 20 were deep mines (18 gold, 1 silver, and 1 copper) and 47 were placers (33 hydraulic, 10 surface placers, and 4 dredges).

The southwestern counties in Oregon which contain an extension of the California gold belt are Benton, Coos, Curry, Douglas, Jackson, Josephine, and Lane. These counties (except Benton and Lane, which reported no production) had a combined output of $57,250 in gold and 325 ounces of silver, valued at $353, a total of $57,603. The production of placer gold in this region in 1920 was $52,996, a decrease of $17,329, and the production of gold from deep mines was $4,254, an increase of $2,371.

Four mines were productive in 1920 in Coos County, 5 in Curry, 5 in Douglas, 7 in Jackson, and 15 in Josephine.

Northeastern Oregon comprises the counties of Baker, Crook, Grant, Harney, Malheur, Umatilla, Wallowa, and Wheeler. Of these Crook, Harney, Umatilla, and Wallowa made no output in 1920. The combined yield of gold in the other four counties was $960,240, of which Baker County produced $890,380. This was an increase of $55,657. The lode mines produced $562,119 in gold and the placers $398,121. The total silver was 82,418 fine ounces, valued at $89,837.

PRODUCTION.

SUMMARY.

Gold, silver, copper, and lead produced in Oregon, 1911–1920.

Year.	Number of mines producing.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine oz.*	*Pounds.*	*Pounds.*	
1911	176	98,558	$633,407	45,221	93,136	.....	$669,016
1912	210	90,945	770,041	57,081	260,429	39,317	849,886
1913	173	155,901	1,627,710	179,036	43,330	87,207	1,746,402
1914	105	124,331	1,591,461	142,552	39,248	16,436	1,676,153
1915	95	155,791	1,861,796	117,947	451,172	62,957	2,003,509
1916	108	159,071	1,902,179	231,342	3,581,886	28,000	2,937,478
1917	76	142,438	1,491,798	125,656	2,474,487	.....	2,270,874
1918	120	126,681	1,270,465	107,323	2,451,016	10,601	1,983,942
1919	78	96,173	977,845	111,121	2,214,815	.....	1,514,255
1920	67	82,156	1,017,490	82,743	2,355,276	.....	1,541,051
Increase or decrease, 1920	−11	−14,017	+39,645	−28,378	+140,461	.....	+26,796

[1] For the preparation of the tables and other statistical data in this chapter the writer is indebted to Mrs. Daisy A. Otis.

The ore treated or sold averaged $7.93 a ton in gold and silver, as compared with $7.46 in 1919. The average value of all ore per ton in all metals was $13.20 in 1920, as compared with $11.74 in 1919. The siliceous ore, 47,352 tons, yielded $458,652 in gold and silver, an average of $9.68 a ton. The 34,804 tons of copper ore had an average value of $5.53 a ton in gold and silver and total value in all metals of $17.99 a ton.

GOLD.

The largest yield of gold from one county was $890,380 and came as usual from Baker County.

The total output of gold from deep mines in 1920 was valued at $566,373, a decrease of $30,821. Of the gold derived from deep mines $63,996 was recovered by amalgamation, $222,512 by cyanidation, and $279,865 by smelting. Most of the concentrates obtained in gold milling, including $246,366 in flotation concentrates and copper mining operations, were shipped to smelters for treatment. Siliceous ore yielded $394,342, an increase of $2,346, and the copper ore contained $172,031 in gold, a decrease of $33,167.

Mine production of gold in Oregon in 1920, in fine ounces.

County.	Placers.	Deep mines.			Grand total.
		Siliceous ores.	Copper ores.	Total.	
Baker	16,432.21	18,317.92	8,321.99	26,639.91	43,072.12
Coos	127.56	.....	.....	.....	127.56
Curry	43.39	.....	.....	.....	43.39
Douglas	33.82	44.99	.....	44.99	78.81
Grant	2,816.88	542.91	.....	542.91	3,359.79
Jackson	405.09	5.08	.....	5.08	410.17
Josephine	1,953.82	155.72	.....	155.72	2,109.54
Malheur	.....	9.68	.....	9.68	9.68
Wheeler	10.02	.....	.....	.....	10.02
	21,822.79	19,076.30	8,321.99	27,398.29	49,221.08
Increase or decrease	+3,408.80	+113.49	—1,604.46	—1,490.97	+1,917.83

Value of placer gold produced in Oregon in 1920.

County.	Hydraulic mines.	Dredging.	Surface placers.	Total.
Baker	$35,635	[a] $358,864	$102	$394,601
Coos	165	.....	2,472	2,637
Curry	389	.....	508	897
Douglas	492	.....	207	699
Grant	3,313	(a)	.....	3,313
Jackson	8,250	.....	124	8,374
Josephine	40,153	.....	236	40,389
Wheeler	207	.....	.....	207
	88,604	358,864	3,649	451,117

[a] Results of dredging in Grant County included in figures for Baker County.

SILVER.

The silver recovered in Oregon in 1920 by amalgamation was 6,853 ounces and by cyanidation 36,011 ounces. At the smelters, 35,026 ounces, including 28,598 ounces in flotation concentrates, was recovered.

Mine production of silver in Oregon in 1920, in fine ounces.

County.	Placers.	Deep mines.			Grand total.
		Siliceous ore.	Copper ore.	Total.	
Baker	3,849	53,690	18,890	72,580	76,429
Coos	20				20
Curry	3				3
Douglas	3	11		11	14
Grant	716	5,270		5,270	5,986
Jackson	67	1		1	68
Josephine	194	26		26	220
Malheur		2		2	2
Wheeler	1				1
	4,853	59,000	18,890	77,890	82,743
Increase or decrease	+1,183	−30,297	+736	−29,561	−28,378

COPPER.

The mine production of copper in Oregon in 1920 was 2,355,276 pounds, valued at $433,371, an increase in quantity, as compared with 1919, of 140,461 pounds and in value of $21,416. All the copper was derived from Baker County mines.

MINING INDUSTRY.

Gold and silver produced in Oregon in 1920, by methods of treatment.

County.	Ore to gold and silver mills.			Ore to concentrating mills.
	Quantity.	Gold.	Silver.	
	Short tons.		*Fine ounces.*	
Baker	34,631	$264,629	36,561	44,653
Grant	86	899	7	1,680
Jackson	13	105	1	
Josephine	106	3,219	26	
Malheur	20	200	2	
	34,856	269,052	36,597	46,333
Average value per ton		$7.72	$1.14	

County.	Concentrates produced.			Crude ore to smelter.		
	Quantity.	Gold.	Silver.	Quantity.	Gold.	Silver.
	Short tons.		*Fine ounces.*	*Short tons.*		*Fine ounces.*
Baker	7,910	$246,366	28,597	959	$39,701	7,422
Douglas				8	930	11
Grant	101	10,324	5,263			
	8,011	256,690	33,860	967	40,631	7,433
Average value per ton		$32.04	$4.60		$42.02	$8.38

The 34,804 tons of copper ore shipped—6,584 tons more than in 1919—yielded 2,355,276 pounds of copper, or an average of 67.7 pounds to the ton.

Ore sold or treated in Oregon in 1920, in short tons.

County.	Siliceous ore.	Copper ore.	Total ore.
Baker	45,439	34,804	80,243
Douglas	8		8
Grant	1,766		1,766
Jackson	13		13
Josephine	106		106
Malheur	20		20
	47,352	34,804	82,156
Increase or decrease	−20,601	+6,584	−14,017
Average per ton in gold and silver	$9.68	$5.53	$7.93

Mine production of gold, silver, and copper in Oregon in 1920.

County.	Ore.	Quartz gold.		Placer gold.		Total gold.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.	*Fine ounces.*		*Fine ounces.*		*Fine ounces.*	
Baker	80,243	26,639.91	$550,696	16,432.21	$339,684	43,072.12	$890,380
Coos				127.56	2,637	127.56	2,637
Curry				43.39	897	43.39	897
Douglas	8	44.99	930	33.82	699	78.81	1,629
Grant	1,766	542.91	11,223	2,816.88	58,230	3,359.79	69,453
Jackson	13	5.08	105	405.09	8,374	410.17	8,479
Josephine	106	155.72	3,219	1,953.82	40,389	2,109.54	43,608
Malheur	20	9.68	200			9.68	200
Wheeler				10.02	207	10.02	207
	82,156	27,398.29	566,373	21,822.79	451,117	49,221.08	1,017,490

County.	Quartz silver.		Placer silver.		Total silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Fine ounces.*		*Pounds.*		
Baker	72,580	$79,112	3,849	$4,196	76,429	$83,308	2,355,276	$433,371	$1,407,059
Coos			20	22	20	22			2,659
Curry			3	3	3	3			900
Douglas	11	12	3	3	14	15			1,644
Grant	5,270	5,745	716	781	5,986	6,526			75,979
Jackson	1	1	67	73	68	74			8,553
Josephine	26	28	194	211	220	239			43,847
Malheur	2	2			2	2			202
Wheeler			1	1	1	1			208
	77,890	84,900	4,853	5,290	82,743	90,190	2,355,276	433,371	1,541,051

PRODUCTION BY COUNTIES.

BAKER COUNTY.

The metals mined in Baker County in 1920 were valued at $1,407,059, as compared with $1,328,942 in 1919. The production of gold from deep mines decreased $39,628 and the value of the silver decreased $19,074, whereas the production of copper increased 259,785 pounds. The placer mines of the county produced $339,684 in gold in 1920, or $92,145 more than in 1919. The value of silver from placers was $4,196, as compared with $3,132 in 1919. There were nine productive deep mines and eight placers in the county in 1920, five less than in 1919. The siliceous ore mined (45,439 tons compared with 67,422 tons in 1919) produced $378,665 in gold and 53,690 fine ounces of silver, an average recoverable value in gold and silver of $9.62 a ton as compared with $6.88 in 1919.

The 34,631 tons of siliceous ore treated at gold and silver mills produced $264,629 in gold and 35,561 ounces of silver, an average value of $8.79 a ton, as compared with $6.94 in 1919. From 44,653 tons of ore concentrated were derived 7,910 tons of concentrates, which yielded $246,366 in gold and 28,597 ounces of silver, a recovery of $6.22 per ton of ore and $35.09 per ton of concentrates. The 959 tons of ore shipped to smelters produced $39,701 in gold and 7,422 fine ounces of silver.

Baker district.—In the Baker district the Mother Lode Gold Mines Co., Conbest, and a number of small deep mines and placers made a total production in gold and silver of $78,516. The value of the gold from deep mines was $41,816, and that from placers $34,542.

Bridgeport district.—In the Bridgeport district only a little gold from a clean-up was obtained by the Superior Dredging Co., which, however, will be productive in 1921.

Cornucopia district.—The yield of the Cornucopia district was all from the Cornucopia Mines Co. (Union Companion and Last Chance group), at Cornucopia, which has two 20-stamp mills and a cynanide plant of 200 tons capacity. These properties are developed by two vertical shafts, 400 and 800 feet deep, and two adits, 1,600 and 2,200 feet long. In 1920 two crosscut tunnels were started to cut the veins at depth.

Cracker Creek district.—The Eureka Excelsior group, at Bourne, the equipment of which consists of a 20-stamp mill and flotation plant, was the only producer in the Cracker Creek district.

Dixie district.—The Dixie was a small producer and has a 5-stamp mill run by steam instead of gas engine as formerly.

Hereford and Huntington district.—The Fourth of July hydraulic mine, at Hereford, was productive; and the Bay Horse quartz mine, at Huntington, produced ore carrying silver and copper but no gold. The ore was shipped to the Tacoma smelter.

Irondyke district.—The Homestead-Iron Dyke Mines Co., at Homestead, is the most productive mining enterprise in Oregon. It produces considerable gold and silver, but its main output is copper. It has a 100-ton crushing and flotation plant. The process of reduction consists of grinding in ball mills, flotation in Janney machines, and treatment in filter press, and concentrates are shipped to the International Smelting Co., Salt Lake City, Utah. About 480 feet of

drifts, crosscuts, and raises were made in 1920. The mine was operated through the new vertical shaft, and the underground inclined shaft in adit No. 4 was closed. The plant was operated all the year.

Rye Valley district.—The Cartwright hydraulic mine, at Rye Valley, had a small output, but no gold was reported from any deep mine.

Sumpter district.—The productive mines in the Sumpter district were the Powder River Gold Dredging Co. (one dredge), at Sumpter, which operated nine months only; the Sumpter Gold Dredging Co. (one dredge), at Sumpter, which operated from April 9 to December 31 on Cracker Creek; and the Stevenson hydraulic mine.

Unity district.—The Bull Run Mining Co. (Oversight mine), equipped with a 10-stamp mill of about 25 tons daily capacity, was the only productive property in the Unity district.

COOS AND CURRY COUNTIES.

In Coos County a few small placers produced gold at Bandon. The Camp Day or Whiskey Run hydraulic mine and the Logsden beach mine, at Bullards, each produced a small quantity of gold. The output of Coos County in 1920 was only $2,659 in gold and silver. In Curry County the Prince Albert is a small surface placer and the Porphyry Dyke is a beach mine in the Sixes district, and Trowbridge & Co. a hydraulic mine at Marial. The Sullivan beach mine on the ocean at Cape Blanco produced considerable platinum and iridium but little gold. Curry County produced altogether $897 in placer gold and $3 in placer silver in 1920.

DOUGLAS COUNTY.

The placer mines producing in Douglas County in 1920 were the old Miller hydraulic, in the Glendale district; the Victor hydraulic, in the Koler district; and the Gopher and Russell Gulch and other small mines on Days Creek, in the Perdue district. None of these mines were worked more than two months in the water season. The only deep mine worked in the county was the Continental, at Nugget, in the Myrtle Creek district, which was operated by lessees. The output of Douglas County in 1920 was $1,629 in gold and $15 in silver.

GRANT COUNTY.

Of the 12 productive mines in Grant County in 1920, 1 was a dredge, 6 were hydraulic, and 5 were deep gold mines. The deep-mine output was $11,223 in gold and $5,745 in silver. The placers produced $58,230 in gold and $781 in silver. Of the producing deep mines the Belmont, in the Austin district; the Hazelton, in the Canyon district; the Skyscraper group, in the Dayville district; and the Cougar in the Granite district made nominal outputs. The only deep producer of note was the Ben Harrison, at Granite, in the Greenhorn district, equipped with a 125-ton mill in which the ore is crushed to 65 mesh and treated by flotation. This property was worked by one shift only during the summer months and was closed in October on account of labor conditions and high costs. Some development work was done during the year.

The principal placer in the county is that worked by the Empire Gold Dredging & Mining Co. on John Day River near John Day, in

the Canyon district. All other placers in the county are hydraulic mines, which worked only from one to four months during the water season. These are the Quartz Gulch, at Canyon City, and small mines at Canyon City and John Day, in the Canyon district, the Big Nugget and Onion Creek, in the Granite district, and the Gumbo, in the Susanville district.

JACKSON COUNTY.

There were only seven productive mines in Jackson County in 1920. The deep mine output was $105 in gold and $1 in silver; the placer mine output was $8,374 in gold and $73 in silver. The producing hydraulic mines were the Pacific Placer Co. (Layton), and Sterling mine, both in the Applegate district. Smaller mines were also worked at Applegate, Gold Hill, and Jacksonville and near Medford. The only productive deep mine was the Rogue River.

JOSEPHINE COUNTY.

The total output of gold and silver in Josephine County in 1920 was valued at $43,847, or $21,856 less than in 1919. Most of this decrease was due to the fact that no copper was produced in 1920, although 118,501 pounds was produced in 1919. Fifteen mines reported production in 1920, or 7 less than in 1919. Of these, 11 were hydraulic mines, 1 a surface placer, and 3 deep gold mines. The deep mines produced $3,219 in gold and $28 in silver, and the placers produced $40,389 in gold and $211 in silver in 1920.

The January First mine, at Holland, was operated only for about 60 days. It is equipped with a crusher, a 3-stamp mill, and a Wilfley table. The Surprise Mining Co., at Holland, has suspended operations. Some gold from the Victor mine, at Merlin, was hand mortared, but a 3-stamp mill has since been installed. Of the placers of the county the Forest Queen, Oscar Creek, and a number of small hydraulic mines were worked in the vicinity of Grants Pass. At Holland, in the Althouse Creek district, the Mint & Bullion, Kentta Bros., Thresher & Lawless, and a few others were productive hydraulic mines. Anderson & Wilson hydraulicked considerable gold at Kerby, as did the Columbia Mines Co., at Placer, in the Grave Creek district, and the Ruble, at Wolf Creek. The most productive hydraulic mine in the county was the Esterly, at Waldo. None of these mines were worked more than a few months.

MALHEUR AND WHEELER COUNTIES.

One deep mine reported a small production in Malheur County, and one hydraulic mine was worked in a small way in Wheeler County.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA.

(MINES REPORT.)

By C. N. Gerry.[1]

PRODUCTION.

GENERAL STATEMENT.

The value of the mine production of gold, silver, copper, lead, and zinc in Montana in 1920 increased nearly 6 per cent over that of 1919. The value of all metals except gold and silver increased considerably, though the quantity of lead was less. Silver Bow County, which includes the Butte or Summit Valley district, continued to produce most of the silver, copper, lead, and zinc, but most of the gold was mined in other districts. Dividends declared by three mining companies in 1920 amounted to $7,203,750, most of which was paid by the Anaconda Copper Mining Co.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine oz.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	457	4,183,594	$2,229,588	12,541,181	169,981,288	34,437,764	168,763,823	$62,037,191
1920	457	5,241,615	1,851,165	12,579,178	177,059,260	31,253,916	184,337,786	65,573,047
Increase or decrease, 1920		+1,058,021	−378,423	+37,997	+7,077,972	−3,183,848	+15,573,963	+3,535,856

[a] Includes placer production.

ORE.

The ore sold or treated in Montana increased more than 25 per cent, but the average value per ton decreased from $14.76 in 1919 to $12.45 in 1920. More than 62 per cent of the ore was concentrated, nearly 2 per cent was treated in gold and silver mills, and about 3 per cent was shipped directly to smelters. The remainder, nearly 33 per cent, consisted of ore leached and old tailings, which were shipped, concentrated, or cyanided. Mines in Silver Bow County produced nearly 96 per cent of the total ore. Copper ore

[1] The work of compiling the statistical tables in this report was done by B. N. Patchell, of the United States Geological Survey.

amounted to more than 76 per cent of the total, lead-zinc ore to nearly 13 per cent, zinc ore to more than 6 per cent, siliceous ore to more than 3 per cent, and all other kinds to slightly more than 1 per cent.

Deer Lodge County produced chiefly oxidized iron ore mined in the Georgetown district. Sulphide iron ore containing considerable gold was produced in Madison County. The siliceous ore had an average assay per ton of $5.25 in gold, 11.21 ounces of silver, and a few pounds of copper and lead.

Of the output of copper ore 2,258,942 tons was of milling grade and produced 757,981 tons of concentrate, which averaged 43 cents in gold and 6.66 ounces of silver to the ton and 9.20 per cent of copper and had an average value of $41.53 a ton. The copper ore of shipping grade, mostly sulphides, contained 21 cents in gold and 4.30 ounces of silver to the ton and 4.17 per cent of copper and had an average value of $20.24 a ton.

Of the output of lead ore 20,357 tons was shipped directly to the smelters. This ore contained $2.27 in gold and 25.15 ounces of silver to the ton, 0.14 per cent of copper, and 11.32 per cent of lead and had an average value per ton of $48.33. Lead concentrates amounting to 12,812 tons were made from lead ore and lead-zinc ore and averaged $1.87 in gold and 28.94 ounces of silver to the ton, 0.14 per cent of copper, and 30.66 per cent of lead. The average value of all lead concentrates was $83 a ton.

All the lead-zinc ore was milled and produced lead concentrate, zinc concentrate, and lead-zinc concentrate.

Zinc concentrates recovered from zinc ore and lead-zinc ore averaged 61 cents in gold and 13.02 ounces of silver to the ton, 0.75 per cent of copper, 2.43 per cent of lead, and 34.18 per cent of zinc, with a total average value of $76.85 a ton. The lead-zinc concentrate contained 41 cents in gold and 12.02 ounces of silver to the ton, 0.03 per cent of copper, 6.38 per cent of lead, and 28.92 per cent of zinc; the average value was $70.68 a ton.

Ore and metals produced in Montana in 1920.

Source of production.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.
		Short tons.	*Fine oz.*	*Fine oz.*	*Pounds.*	*Pounds.*	*Pounds.*
Placers	65	.....	13,977.76	2,210	.....	.....	.....
Dry or siliceous ore	241	178,352	45,293.42	2,000,162	358,808	611,004	.....
Copper ore	52	4,002,491	18,720.88	6,030,507	172,581,159	1,847	.....
Lead ore	103	64,563	3,084.34	800,856	199,951	9,583,916	.....
Zinc ore	4	328,513	3,102.00	1,166,634	2,436,958	6,242,214	43,673,695
Copper-lead ore	8	1,787	113.83	38,685	62,508	375,072	.....
Lead-zinc ore	7	664,664	5,142.89	2,531,685	1,395,912	14,400,009	140,581,576
Copper-lead-zinc ore	1	1,245	114.99	8,439	23,964	39,854	82,515
	.....	5,241,615	89,550.11	12,579,178	177,059,260	31,253,916	184,337,786

Ore sold or treated in Montana in 1920, in short tons.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Copper-lead-zinc ore.	Total.
Beaverhead	4,507	42	8,971	.....	591	.....	.....	14,111
Broadwater	146	75	699	.....	31	.....	.....	951
Cascade	2,369	7	20,145	.....	14	.....	.....	22,535
Deer Lodge	4,443	.....	.....	.....	.....	.....	.....	4,443
Fergus	15,957	.....	.....	.....	.....	.....	.....	15,957
Granite	19,167	112	241	.....	19	.....	.....	19,539
Jefferson	12,702	343	25,927	.....	.....	198	.....	39,170
Lewis and Clark	45,763	37	7,418	.....	34	.....	.....	53,252
Lincoln	.....	.....	.....	.....	.....	30,875	.....	30,875
Madison	3,975	4	658	.....	.....	.....	.....	4,637
Meagher	.....	63	.....	.....	.....	.....	.....	63
Mineral	33	258	88	.....	.....	.....	.....	379
Missoula	.....	38	.....	.....	.....	.....	.....	38
Park	20,000	26	266	.....	.....	.....	.....	20,292
Powell	243	.....	137	.....	1,090	.....	.....	1,470
Sanders	.....	48	.....	.....	.....	.....	.....	48
Silver Bow	49,047	4,001,438	13	328,513	.....	633,591	1,215	5,013,847
Toole	.....	.....	.....	.....	8	.....	.....	8
	[a] 178,352	4,002,491	64,563	328,513	1,787	664,664	1,245	5,241,615
Value per ton in gold and silver	$17.47	$1.74	$14.51	$4.07	$24.91	$4.31	$9.30	$2.91

[a] Includes 98,307 tons of gold ore, 847 tons of gold and silver ore, and 79,198 tons of silver ore.

GOLD.

The output of gold in Montana decreased nearly 17 per cent. Since 1915 the decrease has been $3,153,030. Silver Bow County had the largest output, followed by Lewis and Clark and Madison counties. Most of the placer gold resulted from the operation of dredges in Alder Gulch, Madison County, where for several years the production has been decreasing. The output of gold from Deer Lodge and Lewis and Clark counties decreased considerably. Nearly 29 per cent of the gold was produced at amalgamation and cyanidation mills, which yielded an average recovery of $6.45 a ton of ore and tailings treated. More than 31 per cent of the gold was contained in concentrates of all kinds, and crude ore shipped to smelters contained nearly 22 per cent of the total; nearly 51 per cent came from dry or siliceous ores, nearly 21 per cent from copper ore, nearly 16 per cent from placers, and nearly 6 per cent from lead-zinc ore; but gold decreased from all these sources except copper ore.

Nearly 66 per cent of the total gold in 1920 was produced from eight properties. Three of these produced more than $200,000 each—the Shannon-Piegan-Gloster mines, near Marysville, from siliceous ores; the Anaconda Copper Mining Co., from copper ores; and the Conrey placers in Alder Gulch, Madison County. The other mines were the North Moccasin, the Jardine, the zinc properties of the Anaconda Co., the Holdfast, and the Butte & Superior.

Mine production of gold in Montana in 1920, in fine ounces.

County.	Placers.	Deep mines.							Total.
		Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Copper-lead-zinc ore.	
Beaverhead	24.09	1,240.58	1.45	87.08	.....	12.14	.....	.....	1,365.34
Broadwater	250.73	245.21	2.26	19.51	.....	51.91	.....	.....	569.62
Carbon	3.43	.....	.....	.....	.....	.....	.....	.....	3.43
Cascade	.....	82.91	.04	755.82	.....	.29	.....	.....	839.06
Deer Lodge	.....	5,878.14	.....	.....	.....	.....	.....	.....	5,878.14
Fergus	.....	6,394.55	.....	.....	.....	.....	.....	.....	6,394.55
Granite	158.57	2,313.54	2.08	21.04	.....	.87	.....	.....	2,496.10
Jefferson	28.64	2,203.77	22.78	1,614.52	.....	.....	40.01	.....	3,909.72
Lewis and Clark	116.68	15,831.30	17.55	241.84	.....	.....	.....	.....	16,207.37
Lincoln	.....	.....	.....	.....	.....	.....	253.00	.....	253.00
Madison	12,398.85	3,340.20	.04	182.33	.....	.....	.....	.....	15,921.42
Meagher	7.40	.....	1.02	.....	.....	.....	.....	.....	8.42
Mineral	475.38	.....	1.40	.....	.....	.....	.....	.....	476.78
Missoula	31.83	.....	1.21	.....	.....	.....	.....	.....	33.04
Park	22.84	3,306.24	5.80	3.67	.....	.....	.....	.....	3,338.55
Powell	314.63	26.36	.....	158.53	.....	48.62	.....	.....	548.14
Ravalli	6.29	.....	.....	.....	.....	.....	.....	.....	6.29
Sanders	1.16	.....	.73	.....	.....	.....	.....	.....	1.89
Silver Bow	137.24	4,430.62	18,664.52	.....	3,102.00	.....	4,849.88	114.99	31,299.25
	13,977.76	[a]45,293.42	18,720.88	3,084.34	3,102.00	113.83	5,142.89	114.99	89,550.11

[a] Includes 38,284.51 ounces from gold ore, 423.20 ounces from gold and silver ore, and 6,585.71 ounces from silver ore.

SILVER.

Silver produced by mines in Montana in 1920 increased less than 1 per cent in quantity, but the value of the output decreased $334,819. Most of the silver was obtained from copper ore and lead-zinc ore; the former yielded nearly 48 per cent of the total and the latter more than 20 per cent. More than 84 per cent of the silver came from Silver Bow County. Cyanidation and amalgamation mills produced only a fraction of 1 per cent of the silver, concentrates more than 71 per cent, crude ore shipped to smelters 22 per cent, and ore leached and old tailings smelted or leached 6 per cent.

Thirteen properties produced about 84 per cent of the silver, and each of these produced more than 200,000 ounces. Seven of the large mining properties produced more than 400,000 ounces each—the copper and zinc mines of the Anaconda Co. and the Butte & Superior, Elm Orlu, Davis-Daly, North Butte, and Granite-Bimetallic mines. The other large producers were the Cascade Silver, East Butte, Tuolumne, and Emma mines.

Mine production of silver in Montana in 1920, in fine ounces.

County.	Placers.	Deep mines.							Total.
		Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Copper-lead-zinc ore.	
Beaverhead	1	6,214	899	27,481	.....	30,177	.....	.....	64,772
Broadwater	32	313	127	9,565	.....	202	.....	.....	10,239
Cascade	.....	49,968	228	460,172	.....	464	.....	.....	510,832
Deer Lodge	.....	21,328	.....	.....	.....	.....	.....	.....	21,328
Fergus	.....	4,739	.....	.....	.....	.....	.....	.....	4,739
Granite	45	644,179	96	8,742	.....	3,037	.....	.....	656,099
Jefferson	12	248,438	4,885	225,085	.....	.....	2,430	.....	480,850
Lewis and Clark	22	43,963	613	40,701	.....	243	.....	.....	85,542
Lincoln	.....	.....	.....	.....	.....	.....	104,928	.....	104,928
Madison	2,001	21,650	5	13,258	.....	.....	.....	.....	36,914
Meagher	1	.....	7	.....	.....	.....	.....	.....	8
Mineral	18	648	117	3,288	.....	.....	.....	.....	4,071
Missoula	2	.....	275	.....	.....	.....	.....	.....	277
Park	3	771	37	10,586	.....	.....	.....	.....	11,397
Powell	47	3,894	.....	1,918	.....	4,317	.....	.....	10,176
Sanders	.....	.....	867	.....	.....	.....	.....	.....	867
Silver Bow	26	954,057	6,022,351	60	1,166,634	.....	2,424,327	8,439	10,575,894
Toole	.....	.....	.....	.....	.....	245	.....	.....	245
	2,210	[a]2,000,162	6,030,507	800,856	1,166,634	38,685	2,531,685	8,439	12,579,178

[a] Includes 51,541 ounces from gold ore, 8,906 ounces from gold and silver ore, and 1,939,715 ounces from silver ore.

COPPER.

The mine production of copper in Montana in 1920 increased more than 4 per cent but was only 55 per cent of the output of 1918.

Silver Bow County, which includes the Butte district, contributed all the copper except 655,452 pounds. Copper ore was the source of nearly all the copper, though zinc ores and lead-zinc ores contained about 2 per cent. Crude ore of all kinds shipped to smelters contained nearly 4 per cent of the copper, and concentrates nearly 81 per cent. The sulphide copper ore of smelting grade contained 6,217,320 pounds, an average content of 4.14 per cent, and the oxidized copper ores contained 97,414 pounds, an average of 8.16 per cent. Tailings, slag, and copper precipitates produced from mine waters contained 27,032,954 pounds.

Ten mines in Montana each produced more than 1,000,000 pounds of copper in 1920. The mines of the Anaconda Copper Mining Co. produced more than all others combined. Other large producers were the North Butte, Davis-Daly, East Butte, Butte & Duluth, and Elm Orlu, and the dump of the Butte Reduction Works.

Mine production of copper in Montana in 1920, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Copper-lead-zinc ore.	Total.
Beaverhead	1,299	14,269	113,140		38,671			167,379
Broadwater		5,133	13		4,376			9,522
Cascade	3,612	1,232	908		722			6,474
Deer Lodge	9,993							9,993
Fergus	1,008							1,008
Granite	66,530	9,439			1,124			77,093
Jefferson	139,263	34,784	80,497			1,500		256,044
Lewis and Clark	892	4,863	3,324		2,975			12,054
Lincoln						24,600		24,600
Madison	2,284	983	1,005					4,272
Meagher		13,984						13,984
Mineral		28,548						28,548
Missoula		4,590						4,590
Park		1,461						1,461
Powell	9,164		1,064		11,270			21,498
Sanders		13,562						13,562
Silver Bow	124,763	172,448,311		2,436,958		1,369,812	23,964	176,403,808
Toole					3,370			3,370
	[a] 358,808	172,581,159	199,951	2,436,958	62,508	1,395,912	23,964	177,059,260

[a] Includes 74,233 pounds from gold ore, 1,229 pounds from gold and silver ore, and 283,346 pounds from silver ore.

LEAD.

The mine production of lead in Montana in 1920 decreased more than 9 per cent from that of 1919, and more than 56 per cent of the output was derived from mines in Silver Bow County. Lead-zinc ore was the source of more than 46 per cent of the lead, lead ore yielded nearly 31 per cent, and zinc ore 20 per cent. Crude ore of all kinds shipped to the smelters contained nearly 18 per cent of the total lead, concentrates nearly 74 per cent, and old tailings and slags more than 8 per cent. Most of the first-class lead ore was sulphide.

Nearly all the lead came from 10 properties, 7 of which produced more than 1,500,000 pounds each. In the order of output they were the zinc mines of the Anaconda Co., the Butte & Superior, Elm Orlu, Snow Storm, Cascade Silver, Emma, and Hecla mines.

Mine production of lead in Montana in 1920, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Copper-lead-zinc ore.	Total
Beaverhead			1,723,514		244,495			1,968,009
Broadwater	1,773		391,897		7,881			401,551
Cascade	64,031		3,051,416		11,701			3,127,148
Fergus	358							358
Granite			69,137		6,896			76,033
Jefferson	289,876		3,109,981			14,500		3,414,357
Lewis and Clark	3,930	1,847	785,331		38,879			829,987
Lincoln						3,328,265		3,328,265
Madison	5,024		282,384					287,408
Mineral			43,848					43,848
Park			95,680					95,680
Powell			25,870		62,851			88,721
Silver Bow	246,012		4,858	6,212,214		11,057,244	39,854	17,590,182
Toole					2,369			2,369
	[a] 611,004	1,847	9,583,916	6,212,214	375,072	14,400,009	39,854	31,253,916

[a] Includes 9,016 pounds from gold ore and 601,988 pounds from silver ore.

ZINC.

The mine production of recoverable zinc in Montana in 1920 increased more than 9 per cent over that of 1919. Nearly all the zinc came from Silver Bow County. All the zinc material was sulphide, and it was all milled. Lead-zinc ore was the source of 76 per cent of the recoverable zinc, and zinc ore contained nearly all the remainder. During 1920 much of the zinc concentrate from the Butte mines was shipped to the electrolytic zinc plant at Great Falls, which produced 101,332,458 pounds of electrolytic zinc and 5,255,452 pounds of zinc in dross, as is shown in the report of the Anaconda Copper Mining Co. under Silver Bow County.

In 1920 five mines at Butte produced nearly all the zinc—the Butte & Superior, Elm Orlu, Anaconda (zinc), Emma, and Davis-Daly.

Mine production of recoverable zinc in Montana in 1920, in pounds.

County.	Zinc ore.	Lead-zinc ore.	Copper-lead-zinc ore.	Total.
Jefferson		40,460		40,460
Lincoln		484,383		484,383
Silver Bow	43,673,695	140,056,733	82,515	183,812,943
	43,673,695	140,581,576	82,515	184,337,786

MINING INDUSTRY.

In the early part of 1920 there was a general improvement in mining conditions in Montana. Metal prices were high and the demand for metals was good, though costs were still high and labor conditions far from satisfactory. The mines and smelters produced during the first quarter approximately 20,000,000 pounds of copper a month, as compared with 25,000,000 pounds a month in 1918 and 14,000,000 pounds in 1919. Later in the year the demand for copper, lead, and zinc was poor, prices declined, and as a result the average monthly output of copper was reduced to about 15,000,000 pounds. The production of zinc was greater and that of silver increased slightly. All the smelting and leaching plants were operated in 1920 and an unusual amount of development work was done in the mines at Butte, notwithstanding a labor strike in April and the excessive cost of supplies.

METALLURGIC INDUSTRY.

Thirty-three milling plants of various kinds were active in Montana in 1920, though many of them were operated for only a short time. They included 5 plants using the amalgamation process, 4 using amalgamation and concentration, 6 equipped for cyanidation, 1 using amalgamation and cyanidation, 1 using amalgamation, concentration, and cyanidation, 3 using table concentration, and 8 using oil-flotation equipment after table concentration. Two copper-precipitating plants that extracted copper from mine waters, 1 copper-leaching plant, 1 electrolytic zinc-leaching plant, and 1 leaching plant using a chloridizing roast are included in the total. A complete list of milling plants giving the process and equipment of each has been prepared for the year 1920, and a copy of it may be had by addressing the Director, Bureau of Mines, Washington, D. C.

Of the ore and old tailings treated at gold and silver mills, 27,989 tons was treated by amalgamation with an average recovery per ton of $2.56 in gold and 0.07 ounce of silver and 60,999 tons by cyanidation with an average recovery per ton of $7.58 in gold and 0.58 ounce of silver. During 1920, 250 pounds of mercury and 105,874 pounds of sodium cyanide were used in gold and silver mills. The consumption of mercury was 0.0089 pound of mercury per ton of ore amalgamated and 0.046 pound of mercury per ounce of bullion recovered. The consumption of cyanide was 1.84 pounds per ounce of gold and silver bullion and 1.74 pounds per ton of ore and tailings treated. The decrease in bullion recovered by cyanidation was considerable.

Gold and silver produced at mills in Montana in 1920.

County.	Ore.	Bullion recovered from ore by—				Total value.
		Amalgamation.		Cyanidation.		
		Gold.	Silver.	Gold.	Silver.	
	Short tons.	*Fine oz.*	*Fine oz.*	*Fine oz.*	*Fine oz.*	
Beaverhead	4,419	760.63	613	464.24	356	$26,376
Broadwater	11	213.57	59	.....	.....	4,479
Deer Lodge	2	2.25	1	.....	.....	48
Fergus	15,776	.....	.....	[a]6,038.95	2,529	127,593
Granite	[b]974	123.91	12	.....	.....	2,574
Jefferson	63	[c]168.28	[c]116	.....	.....	3,606
Lewis and Clark	34,861	81.07	23	[d]15,565.05	[d]30,611	356,858
Madison	[e]2,337	1,057.35	852	291.90	1,696	30,668
Park	[f]20,000	1,055.28	357	.....	.....	22,204
	78,443	3,462.34	2,033	22,360.14	35,222	574,406

[a] Includes bullion from 15 tons of old tailings.
[b] Also yielded 65 tons of concentrates.
[c] Includes bullion from 80 tons of old tailings.
[d] Includes bullion from 10,450 tons of old tailings.
[e] Also yielded 49 tons of concentrates.
[f] Also yielded 1,365 tons of concentrates.

Mills in Montana equipped for the concentration of low-grade ore treated most of the ore mined. The concentrates produced had an average value of $51.14 a ton. The decrease in copper and lead-zinc concentrates was pronounced.

Mine production of metals from Montana concentrates, 1920.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cascade	13,654	4,892	544.67	179,252	.....	1,712,329	.....	$343,630
Granite	.....	65	492.51	798	.....	.....	.....	11,051
Jefferson	198	55	40.00	2,430	1,500	14,500	40,460	8,189
Lewis and Clark	6,484	1,204	156.32	30,637	1,295	586,996	.....	83,823
Lincoln	30,875	4,282	253.00	104,928	24,600	3,328,265	484,383	429,623
Madison	.....	49	214.18	484	.....	3,086	.....	5,203
Mineral	258	86	1.42	117	28,548	.....	.....	5,410
Park	.....	1,365	2,250.94	414	.....	.....	.....	46,982
Powell	1,090	218	48.62	4,317	11,270	62,851	.....	12,812
Silver Bow	3,220,788	1,033,707	23,837.16	8,645,623	143,200,644	17,339,312	183,812,943	52,541,400
	3,273,347	1,045,923	27,838.82	8,969,000	143,267,857	23,047,339	184,337,786	53,488,123

By kinds of concentrates.

Dry or siliceous	.....	1,701	2,862.63	6,158	4,317	.....	.....	$66,682
Copper	.....	757,981	15,771.71	5,046,340	139,398,458	.....	.....	31,475,857
Lead	.....	12,812	1,158.30	370,821	36,880	7,855,954	.....	1,063,401
Zinc	.....	250,311	7,429.56	3,259,523	3,778,968	12,185,944	171,098,023	19,235,609
Copper-lead	.....	218	48.62	4,317	11,270	62,851	.....	12,813
Lead-zinc	.....	22,750	453.00	273,402	14,000	2,902,736	13,157,248	1,607,904
Copper-lead-zinc	.....	150	115.00	8,439	23,964	39,854	82,515	25,857

Crude ore directly smelted averaged $28.33 a ton. The accompanying table shows that there was a large decrease in siliceous and copper ore.

Mine production of metals from Montana crude ore shipped to smelters in 1920.

By counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Beaverhead	950	87.21	39,381	56,358	307,238	$79,677
Broadwater	914	92.47	10,011	9,522	400,495	46,615
Cascade	8,812	294.41	331,418	6,474	1,409,779	481,305
Deer Lodge	4,441	5,875.88	21,327	9,993	.....	146,550
Fergus	166	355.58	2,210	1,008	358	9,974
Granite	15,565	1,720.05	647,293	55,598	76,033	757,419
Jefferson	23,216	3,476.70	422,299	225,274	2,389,798	764,810
Lewis and Clark	1,457	288.27	24,219	10,759	242,991	53,777
Madison	2,300	1,959.17	31,881	4,272	284,322	98,782
Meagher	63	1.00	7	13,984	.....	2,602
Mineral	88	.....	3,288	.....	43,848	7,092
Missoula	38	1.23	275	4,590	.....	1,170
Park	292	9.49	10,623	1,461	95,680	19,698
Powell	380	184.87	5,812	10,228	25,870	14,108
Sanders	48	.75	867	13,562	.....	3,455
Silver Bow	123,333	5,116.08	1,265,806	6,331,996	250,870	2,670,645
Toole	8	.....	245	3,370	2,369	1,076
	182,071	19,463.16	2,816,962	6,758,449	5,529,651	5,158,755

By kinds of ore.

Dry or siliceous	85,287	16,397.84	1,944,614	334,112	607,918	$2,568,712
Copper	75,730	759.20	325,953	6,314,734	1,847	1,533,042
Lead	20,357	2,240.92	512,027	58,365	4,607,665	983,786
Copper-lead	697	65.20	34,368	51,238	312,221	73,215

PRODUCTION BY COUNTIES.

GENERAL FEATURES.

The following tables give the production of each metal by counties, the production of ore and its average value per ton by counties, and the output of the placer mines. They are followed by a review of the mining industry for each county and each important producing mining district. Mention is not made of many districts in which production was small.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1920.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total value.	Quantity (fine ounces).	Value.
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.			
Beaverhead	24.09	$498	1,341.25	$27,726	$28,224	64,772	$70,601
Broadwater	250.73	5,183	318.89	6,592	11,775	10,239	11,160
Carbon	3.43	71			71		
Cascade			839.06	17,345	17,345	510,832	556,807
Deer Lodge			5,878.14	121,512	121,512	21,328	23,248
Fergus			6,394.55	132,187	132,187	4,739	5,166
Granite	158.57	3,278	2,337.53	48,321	51,599	656,099	715,148
Jefferson	28.64	592	3,881.08	80,229	80,821	480,850	524,126
Lewis and Clark	116.68	2,412	16,090.69	332,624	335,036	85,542	93,241
Lincoln			253.00	5,230	5,230	104,928	114,372
Madison	12,398.85	256,307	3,522.57	72,818	329,125	36,914	40,236
Meagher	7.40	153	1.02	21	174	8	9
Mineral	475.38	9,827	1.40	29	9,856	4,071	4,437
Missoula	31.83	658	1.21	25	683	277	302
Park	22.84	472	3,315.71	68,542	69,014	11,397	12,423
Powell	314.63	6,504	233.51	4,827	11,331	10,176	11,092
Ravalli	6.29	130			130		
Sanders	1.16	24	.73	15	39	867	945
Silver Bow	137.24	2,837	31,162.01	644,176	647,013	10,575,894	11,527,724
Toole						245	267
	13,977.76	288,946	75,572.35	1,562,219	1,851,165	12,579,178	13,711,304

County.	Copper.		Lead.		Recoverable zinc.		Total value.
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	
Beaverhead	167,379	$30,798	1,968,009	$157,441			$287,064
Broadwater	9,522	1,752	401,551	32,124			56,811
Carbon							71
Cascade	6,474	1,191	3,127,148	250,172			825,515
Deer Lodge	9,993	1,839					146,599
Fergus	1,008	185	358	29			137,567
Granite	77,093	14,185	76,033	6,083			787,015
Jefferson	256,044	47,112	3,414,357	273,148	40,460	$3,277	928,484
Lewis and Clark	12,054	2,218	829,987	66,399			496,894
Lincoln	24,600	4,526	3,328,265	266,261	484,383	39,235	429,624
Madison	4,272	786	287,408	22,993			393,140
Meagher	13,984	2,573					2,756
Mineral	28,548	5,253	43,848	3,508			23,054
Missoula	4,590	845					1,830
Park	1,461	269	95,680	7,654			89,360
Powell	21,498	3,956	88,721	7,098			33,477
Ravalli							130
Sanders	13,562	2,495					3,479
Silver Bow	176,403,808	32,458,301	17,590,182	1,407,214	183,812,943	14,888,849	60,929,101
Toole	3,370	620	2,369	189			1,076
	177,059,260	32,578,904	31,253,916	2,500,313	184,337,786	14,931,361	65,573,047

Ore sold or treated, mines producing, and average value per ton of ores in Montana in 1919 and 1920.

County.	Ore sold or treated, 1920 (short tons).		Number of deep mines producing.		Average value per ton.[a]		Average value per ton in gold and silver.[a]	
	Quantity.	Increase or decrease.	1919	1920	1919	1920	1919	1920
Beaverhead	14,111	+ 7,816	19	13	$32.08	$20.31	$16.75	$6.97
Broadwater	951	+ 731	17	18	75.91	54.25	51.04	18.63
Cascade	22,535	+ 5,632	23	25	44.32	36.63	35.28	25.48
Deer Lodge	4,443	− 17,560	10	7	14.04	32.99	13.51	32.58
Fergus	15,957	− 26,211	5	6	5.05	8.62	5.04	8.61
Gallatin	.....	− 100	1	.....	4.95	.....	4.95	.....
Granite	19,539	− 5,066	45	42	31.03	40.11	30.23	39.07
Jefferson	39,170	+ 5,957	51	70	27.37	23.69	20.13	15.43
Lewis and Clark	53,252	− 5,148	41	40	10.99	9.28	10.67	8.00
Lincoln	30,875	− 31,144	2	1	10.27	13.91	3.16	3.87
Madison	4,637	− 133	62	49	23.10	29.04	19.37	23.91
Meagher	63	− 34	8	2	51.92	41.30	20.53	.46
Mineral	379	− 623	2	3	13.73	34.85	2.76	11.73
Missoula	38	− 196	3	1	10.03	30.79	8.91	8.55
Park	20,292	+ 16,306	3	3	12.13	4.38	11.33	3.99
Powell	1,470	+ 1,039	14	9	29.29	18.31	19.80	10.79
Sanders	48	− 11	3	3	73.27	71.98	24.39	20.00
Silver Bow	5,013,847	+1,106,758	86	99	14.62	12.15	3.17	2.43
Toole	8	+ 8	.....	1	.....	134.50	.....	33.38
	5,241,615	+1,058,021	395	392	14.76	12.45	3.82	2.91

[a] Value per ton, placer product excluded.

Number and production of producing placer mines in Montana in 1919 and 1920.

County.	1919						1920					
	Mines.			Gold.	Silver.	Total value.	Mines.			Gold.	Silver.	Total value.
	Hydraulic, dry, and sluicing.	Dredging.	Drift.				Hydraulic, dry, and sluicing.	Dredging.	Drift.			
					Fine ounces.						*Fine ounces.*	
Beaverhead	4	.....	.....	$748	2	$750	1	.....	.....	$498	1	$499
Broadwater	3	.....	.....	639	7	647	5	.....	1	5,183	32	5,218
Carbon	.....	.....	.....	.....	.....	.....	1	.....	.....	71	.....	71
Deer Lodge	1	.....	.....	130	.....	130	.....	.....	.....	.....	.....	.....
Granite	4	.....	.....	4,245	62	4,314	5	.....	.....	3,278	45	3,327
Jefferson	1	.....	.....	107	1	108	4	.....	.....	592	12	605
Lewis and Clark	13	.....	1	3,173	22	3,198	14	.....	.....	2,412	22	2,436
Madison	2	1	.....	265,638	2,152	268,048	5	1	.....	256,307	2,001	258,488
Meagher	.....	.....	.....	.....	.....	.....	1	.....	.....	153	1	154
Mineral	9	.....	.....	5,868	8	5,877	5	.....	.....	9,827	18	9,847
Missoula	9	.....	.....	1,343	5	1,349	6	.....	.....	658	2	660
Park	1	.....	1	1,375	6	1,382	2	.....	.....	472	3	475
Powell	9	.....	1	4,349	27	4,379	7	.....	1	6,504	47	6,555
Ravalli	1	.....	.....	1,509	3	1,512	1	.....	.....	130	.....	130
Sanders	.....	.....	.....	.....	.....	.....	1	.....	.....	24	.....	24
Silver Bow	1	.....	.....	2,306	14	2,322	4	.....	.....	2,837	26	2,866
	58	1	3	291,430	2,309	294,016	62	1	2	288,946	2,210	291,355

BEAVERHEAD COUNTY.

The output of ore in Beaverhead County increased 7,816 tons in 1920, but most of it was old slag which was used as a flux at a lead smelter.

Argenta district.—Three deep mines in the Argenta district produced 170 tons of ore, containing $838 in gold, 2,482 ounces of silver, 522 pounds of copper, and 41,009 pounds of lead, valued in all at $6,920, or $40.70 a ton. Sulphide lead ore was shipped from the Tilden, Tuscarora, and Pilon properties.

Bannack district.—A large production of gold was recovered at the Hendricks mine by amalgamation and cyanidation.

Bryant district (Melrose).—Four deep mines in the Bryant district produced 9,289 tons of ore and old slag, containing $838 in gold, 53,595 ounces of silver, 159,628 pounds of copper, and 1,894,024 pounds of lead, valued in all at $240,151, or $25.85 a ton. Most of the output was old slag from the Hecla dump and copper-lead ore from the Hecla and True Fissure mines.

Elkhorn district (Wise River).—Construction work was continued on the milling plant of the Boston-Montana Corporation. A few lots of sulphide copper-lead ore were shipped to the smelter. The following extracts are taken from the printed report of the company:[2]

> The mill building was completed shortly after the close of the year and installation of machinery is now in progress. The machinery has been contracted for * * * and rapid progress is being made in machinery delivery and installation. * * *
>
> The railroad has been put in shape for handling heavy traffic. * * *
>
> In the total of 3,175 feet of development done in the mine during the year, the ore bodies have been very extensively increased and sufficient ore blocked out to run the mill for several years. * * *

Polaris district.—Several lots of silver ore of good grade were shipped from the Polaris mine.

BROADWATER COUNTY.

The ore mined in Broadwater County in 1920 had a value of $54.25 a ton, and most of it was first-class lead ore.

Backer district (Canton).—Some unusually rich gold ore was treated at the Slim Jim property in a 1-stamp mill. Placer gold was produced at the Confederate claim, near Canton.

Beaver district.—Placer gold was recovered from the Indian Creek property, near Townsend.

Cedar Plains district (Radersburg).—Ten deep mines and one placer in the Cedar Plains district produced 917 tons of ore, $3,111 in gold, 9,387 ounces of silver, 9,509 pounds of copper, and 395,555 pounds of lead, valued in all at $46,737. The ore had an average value of $49.66 a ton. The largest producers were the Daisy-Dandy and Ruby Silver properties, which produced lead ore.

Park district (Townsend).—Five deep mines and two placers in the Park district produced ore and bullion valued at $1,565.

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[2] Boston-Montana Corporation Ann. Rept. for year ending Dec. 31, 1920.

CASCADE COUNTY.

Mine production in Cascade County, Mont., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	23	16,903	$15,087	518,946	6,305	2,860,275	$749,075
1920	25	22,535	17,345	510,832	6,474	3,127,148	825,515
Increase or decrease, 1920.	+2	+5,632	+2,258	−8,114	+169	+266,873	+76,440

At Black Eagle, near Great Falls, the electrolytic zinc plant, copper refinery, rod and wire mill, and ferromanganese plant were actively operated in 1920. The output of refined zinc and copper is given in the report of the Anaconda Copper Mining Co. under Silver Bow County.

The entire output of Cascade County was that of the Montana and Barker district. The greater part of the ore was concentrated, and 4,892 tons of concentrates with 8,812 tons of crude ore was shipped directly to smelters. The largest producer was the Moulton & Broadwater property, operated by the Cascade Consolidated Silver Mines Co. Other large producers were the Neihart Consolidated, Block P., Flohart Silver, Galt, Tom Hendricks, Ripple, and Silver Belt mines. At the Cascade Silver mine the mill was idle four months on account of a labor strike.

DEER LODGE COUNTY.

Mine production in Deer Lodge County, Mont., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	
1919	11	22,003	[a]$289,980	6,637	62,780	$309,091
1920	7	4,443	121,512	21,328	9,993	146,599
Increase or decrease, 1920.	−4	−17,560	−168,468	+14,691	−52,787	−162,492

[a] Includes placer production.

The output of Deer Lodge County consisted largely of gold-bearing iron ore which was used as a flux in smelting. At Anaconda, where most of the ores mined in Montana are treated, the copper leaching plant, copper and zinc concentrators, copper smelting plant, and arsenic plant were active in 1920. The output of copper was about 60 per cent of that of a normal year.

Georgetown district (Southern Cross).—Four deep mines in the Georgetown district produced 4,011 tons of ore, containing $120,132 in gold, 853 ounces of silver, and 9,739 pounds of copper, valued in all at $122,854, or $30.63 a ton. The output consisted of oxidized iron ore containing considerable gold from the Holdfast, Orofino, and Pyrenees mines. The Southern Cross mine, one of the large producers of gold, was idle in 1920 on account of high costs of operation.

Oro Fino district.—Several hundred tons of silver ore was shipped from the Champion mine of the Butte Jardine Metals Co. A concentrator equipped for fine grinding and flotation was under construction during the year.

FERGUS COUNTY.

Mine production in Fergus County, Mont., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	5	42,168	$209,494	2,812	1,288	.....	$212,883
1920	6	15,957	132,187	4,739	1,008	358	137,567
Increase or decrease, 1920	+1	−26,211	−77,307	+1,927	−280	+358	−75,316

All the ore produced in Fergus County was siliceous, and most of it was treated by cyanidation. The ore milled had an average value of $8.09 a ton, and the ore shipped (166 tons) of $60.08 a ton.

Cone Butte district.—One lot of rich silver ore was shipped from the Dardanelles property.

North Moccasin district (Kendall).—A large production of gold was recovered from the North Moccasin mine, and lessees recovered some gold from the Kendall mine. The report of the operating company [3] gives the following notes:

Production of the North Moccasin mine was 9,514 tons of ore of an average assay value of $7.62 a ton, ending with the month of July, when production was but 240 tons. * * *

Total development work, January to September, was 2,279 feet. * * *

Lessees took possession of the mine * * * and during the months of September, October, November, and December, 3,621 tons of ore was mined of a net bullion value of $24,530.41. * * *

The Kendall property was under lease, as for the preceding year, and 2,716 tons of ore was mined and milled with an average assay value of $3.94 a ton. * * * In July the lessees gave up the lease. * * *

The loss in operating the North Moccasin mine was $28,187.

Warm Springs district (Giltedge).—Three deep mines in the Warm Springs district produced 154 tons of ore, containing $7,420 in gold, 875 ounces of silver, and 1,008 pounds of copper, valued in all at $8,559, or $55.58 a ton. The Maginnis was the largest producer.

GRANITE COUNTY.

Mine production in Granite County, Mont., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	49	24,605	$85,891	591,290	84,235	77,618	$767,918
1920	47	19,539	51,599	656,099	77,093	76,033	787,015
Increase or decrease, 1920	−2	−5,066	−34,292	+64,809	−7,142	−1,585	+19,097

[a] Includes placer production.

[3] Barnes King Development Co. Ann. Rept. for year ending Dec. 31, 1920.

The quantity of ore sold or treated in Granite County in 1920 decreased, but the value of the metal output, which was mostly silver, increased nearly 3 per cent.

Dunkleberg district.—Several lots of sulphide lead ore were shipped from the Forest Rose mine.

First Chance district (*Garnet*).—Eight deep mines and three placers in the First Chance district produced 1,287 tons of ore, $21,898 in gold, 1,518 ounces of silver, and 4,923 pounds of copper, valued in all at $24,458. The ore treated had an average of $18.67 a ton. The only large producer was the Fourth of July mine, which produced rich gold ore, part of which was concentrated.

Flint Creek district (*Philipsburg*).—Twenty-six deep mines in the Flint Creek district produced 18,054 tons of ore, containing $26,193 in gold, 646,577 ounces of silver, 69,145 pounds of copper, and 25,786 pounds of lead, valued in all at $745,748, or $41.31 a ton. With the exception of 3,000 tons of tailings leached, the output was first-class silver ore shipped to smelting plants. At the Combination mine old tailings were treated by a chloridizing roast followed by acid leaching. Precipitates containing silver and copper were smelted. As in the past, the Granite-Bimetallic mine was the largest producer of silver ore in the Flint Creek district. Other notable producers were the Philipsburg Mining Co., Young America, Scratchall, Two Percent, and Comstock Extension properties.

South Boulder district (*Maxville*).—Four deep mines in the South Boulder district produced 81 tons of ore, containing $198 in gold, 4,420 ounces of silver, 2,631 pounds of copper, and 6,896 pounds of lead, valued in all at $6,052, or $74.72 a ton. The main producers were the Sunday and Eagle properties.

JEFFERSON COUNTY.

Mine production in Jefferson County, Mont., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	52	33,213	$128,423	482,384	342,018	2,772,805	410,956	$909,267
1920	74	39,170	80,821	480,850	256,044	3,414,357	40,460	928,484
Increase or decrease, 1920..	+ 22	+5,957	−47,602	−1,534	−85,974	+641,552	−370,496	+19,217

[a] Includes placer production.

The increase in the output of lead in Jefferson County was due in part to the shipment of old slag.

Amazon district.—Three small lots of lead ore were shipped from the Independence, Amazon, and Emma May properties.

Bigfoot district.—One lot of rich gold ore was shipped from the State group.

Boulder district.—Five deep mines and one placer in the Boulder district produced 1,070 tons of ore, $2,284 in gold, 16,113 ounces of silver, 43,366 pounds of copper, and 30,986 pounds of lead, valued in all at $30,305. The ore had an average value of $28.24 a ton.

Most of the output was siliceous silver ore shipped from the Baltimore mine. The Shiels & Ironside property produced several lots of sulphide copper ore.

Cataract district (Basin).—Twenty-three deep mines and two placers in the Cataract district produced 10,059 tons of ore and old tailings, $48,611 in gold, 149,410 ounces of silver, 157,075 pounds of copper, 1,228,464 pounds of lead, and 40,460 pounds of recoverable zinc, valued in all at $341,924. The ore had an average value of $33.99 a ton. Most of the output, or 9,371 tons, was crude ore smelted. The largest producers were the Comet, Crystal, Jib, Bullion, Gray Eagle, and West Rumley properties. The Jib mine produced some unusually rich gold ore, and most of the lead came from the Comet and Crystal mines.

Colorado district (Wickes).—Seventeen deep mines in the Colorado district produced 21,018 tons of ore and old slag, containing $19,697 in gold, 128,045 ounces of silver, 47,145 pounds of copper, and 1,846,033 pounds of lead, valued in all at $315,624, or an average of $15.02 a ton. The output consisted of 5,785 tons of crude ore smelted and 15,233 tons of old slag resmelted. Most of the lead ore came from the Mount Washington mine, which was operated only six months, and slag was shipped from the dump of the old Wickes smelter.

Elkhorn district.—Seven deep mines in the Elkhorn district produced 2,447 tons of ore, containing $6,473 in gold, 7,670 ounces of silver, 6,842 pounds of copper, and 9,232 pounds of lead, valued in all at $16,830, or an average of $6.88 a ton. All the ore was smelted, and most of it was iron ore containing gold from the Golden Curry mine.

Lump Gulch district (Clancey).—Twelve deep mines and one placer in the Lump Gulch district produced 4,446 tons of ore, $1,567 in gold, 178,546 ounces of silver, 299 pounds of copper, and 279,214 pounds of lead, valued in all at $218,574. The average value of the ore was $49.06 a ton, and all of it was shipped to smelters. A large production of siliceous silver ore was shipped from the Liverpool mine, and there was much activity and development work in other properties of the district.

LEWIS AND CLARK COUNTY.

Mine production in Lewis and Clark County, Mont., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
Placers:							
1919	14	.....	$3,173	22	.....	.....	$3,198
1920	14	.....	2,412	22	.....	.....	2,436
Deep mines:							
1919	41	58,400	495,530	114,125	25,734	255,570	641,682
1920	40	53,252	332,624	85,520	12,054	829,987	491,458
Increase or decrease, 1920.	−1	−5,148	−163,667	−28,605	−13,680	+574,417	−147,986

The ore mined in Lewis and Clark County decreased nearly 9 per cent in 1920, and most of it was treated in milling plants by cyanida-

tion. The increase in the output of lead only partly offset a large decrease in gold. Smelting of lead ores was continued at East Helena, and the total bullion shipments exceeded those of 1919.

Bald Butte district (*Marysville*).—Old tailings from the Bald Butte dump were cyanided, and several lots of oxidized lead ore were shipped from the Uncle Ben mine.

Dry Gulch district.—One deep mine and five placers in the Dry Gulch district produced gold, silver, and lead valued at $1,145.

Grass Valley district.—Four deep mines in the Grass Valley district produced 186 tons of ore, containing $108 in gold, 7,663 ounces of silver, and 4,040 pounds of lead, valued in all at $8,784, or $47.23 a ton. Several lots of silver ore were shipped from the Nora Darling property.

Helena district.—Three deep mines and three placers in the Helena district produced 716 tons of ore, $1,810 in gold, 6,170 ounces of silver, 288 pounds of copper, and 94,173 pounds of lead, valued in all at $16,122. The ore, which came principally from the Helena mine, had an average value of $22.21 a ton.

Lincoln district.—Lead concentrate containing considerable silver was shipped by the Sterling Mining & Milling Co., which operated the Mike Horse mine.

Ottawa district (*Marysville*).—Twelve deep mines in the Ottawa district produced 35,394 tons of ore and old tailings, containing $314,122 in gold, 35,092 ounces of silver, 4,522 pounds of copper, and 60,891 pounds of lead, valued in all at $358,075, or $10.12 a ton. Nearly all the ore was treated in milling plants by cyanidation. The largest producer was the Barnes King Development Co., which operated the Shannon-Piegan-Gloster mines. The company's report[4] says:

> The production of the Piegan-Gloster mine for five months was 6,505 tons of an average assay value of $10.88 per ton. * * *
>
> All possible efforts were made to get out the little ore that remained, and the mine was shut down the first of June. * * *
>
> The Shannon mine was worked continuously during the year and the production was 27,950 tons of ore of an average assay value of $9.08 per ton. One ore shoot, a short distance west of the main Shannon shoot and on the same fissure, was opened on the 500 level for a length of 400 feet with values of better than $10 per ton. * * *
>
> Development work for the year was 3,527 feet.
>
> The estimated ore in sight at the end of the year was 18,460 tons of an average grade of $10.14 per ton.
>
> Dividends paid in 1920 amounted to $60,000.

Other producers were the Lucky Girl, Towsley & Nile, Drumlummon, and dumps of the Penobscot and Gloster mines.

Scratch Gravel district.—One lot of sulphide lead ore was shipped from the Franklin mine, formerly a large producer.

Seven Mile district.—Several lots of silver ore were shipped from the Saginaw mine.

Stemple district.—Placer gold was shipped from the Tarhead claim and lead ore from the Bell Boy mine.

Unionville district.—Operations were resumed at the Whitlatch property, and some gold bullion was recovered by amalgamation.

Vaughn district (*Rimini*).—Four deep mines and two placers in the Vaughn district produced 3,316 tons of ore, $3,390 in gold, 22,620

[4] Barnes King Development Co. Ann. Rept. for year ending Dec. 31, 1920.

ounces of silver, 1,087 pounds of copper, and 203,309 pounds of lead, valued in all at $44,511. Much of the ore from the district was concentrated at a custom plant at Helena.

LINCOLN COUNTY.

Libby district.—A concentration plant was completed for the Lukens Hazel mine, but no output was reported in 1920.

Troy or Callahan Creek district.—A large quantity of lead-zinc ore was milled by the Snow Storm Mines Consolidated. Lead concentrates were shipped to Midvale, Utah, and zinc concentrates to the electrolytic zinc plant at Black Eagle, near Great Falls, Mont. The output was less than half that of 1919. Receipts from concentrates sold were $273,767, and net profit, exclusive of deduction for depreciation, was $16,285.

MADISON COUNTY.

Mine production in Madison County, Mont., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
Placers:							
1919	3	.....	$265,638	2,152	.....	.....	$268,048
1920	6	.....	256,307	2,001	.....	.....	258,488
Deep mines:							
1919	62	4,770	51,286	36,706	35,949	209,614	110,192
1920	49	4,637	72,818	34,913	4,272	287,408	134,652
Increase or decrease, 1920.	−10	−133	+12,201	−1,944	−31,677	+77,794	+14,900

The increase in gold from deep mines in Madison County was greater than the decrease from placer mines.

Alder Gulch district (Virginia City).—Three deep mines and two placers in the Alder Gulch district produced 266 tons of ore, $258,241 in gold, 7,814 ounces of silver, 303 pounds of copper, and 251 pounds of lead, valued in all at $266,834. The placer output, which was mostly from dredge operations, was valued at $257,822. The Conrey Placer Mining Co., at Ruby, operated one dredge the entire year and another until September 30. Several lots of silver ore were shipped from the U. S. Grant mine.

Lower Hot Springs district (Norris).—Five deep mines in the Lower Hot Springs district produced small lots of ore containing gold and silver.

McCarthy district.—The Hidden Treasure group produced one lot of rich gold ore, and the Polly Jane property some oxidized lead ore.

Mineral Hill district (Pony).—Three deep mines in the Mineral Hill district produced 595 tons of ore, containing $5,019 in gold and 374 ounces of silver, valued together at $5,427. The Boss Tweed & Clipper property, at Pony, produced ore which was treated by amalgamation and concentration.

Norwegian district (Renova).—Some iron ore containing gold and silver was shipped from the Norwegian district to the smelter for use in fluxing.

Rabbit district (*Rochester*).—Five deep mines and one placer in the Rabbit district produced 239 tons of ore, $24,255 in gold, 2,802 ounces of silver, 1,024 pounds of copper, and 18,104 pounds of lead, valued in all at $28,945. The ore was shipped principally from the Pete & Joe and Emma properties.

Ramshorn district (*Laurin*).—Several lots of silver ore and sulphide lead ore were shipped from the Silver King and Shamrock mines.

Sheridan district.—Eight deep mines and two placers in the Sheridan district reported 382 tons of ore, $1,781 in gold, 6,378 ounces of silver, 1,396 pounds of copper, and 111,121 pounds of lead, valued in all at $17,881. The largest producers were the Buckeye, Deutschland, Diadem, and Silver Bar mines.

Silver Star district.—Five deep mines in the Silver Star district produced 92 tons of ore, containing $1,904 in gold, 2,305 ounces of silver, and 1,103 pounds of copper, valued in all at $4,619. Gold ore was shipped from the Greene-Campbell, Emma, and Edgerton, and one lot of silver ore was shipped from the Wheal Clifford property.

Summit district (*Virginia City*).—Seven deep mines in the Summit district produced 205 tons of ore, containing $2,454 in gold and 2,405 ounces of silver, valued together at $5,075. Some gold ore was treated by amalgamation at the Easton-Pacific and Mountain Flower mines.

Tidal Wave district (*Twin Bridges.*)—Seven deep mines in the Tidal Wave district produced 337 tons of ore, containing $5,083 in gold, 5,245 ounces of silver, 373 pounds of copper, and 110,085 pounds of lead, valued in all at $19,676. The largest producers were the Ella and Tidal Wave mines, which produced lead ore.

Washington district.—The Missouri mine produced much gold ore which was treated by amalgamation, concentration, and cyanidation.

MEAGHER COUNTY.

Small lots of copper ore were shipped from the Castle Mountain and Murray districts.

MINERAL COUNTY.

Though the output of ore from Mineral County decreased slightly, the value of the metal content was greater in 1920 than in 1919.

Cedar Creek district (*Iron Mountain, Quartz*).—One deep mine and five placers in the Cedar Creek district produced 258 tons of ore, $9,856 in gold, 135 ounces of silver, and 28,548 pounds of copper, valued in all at $15,256. The output of ore was valued at $5,409. A few lots of copper concentrate from former operations were shipped from the Intermountain mine, which was under development. The largest placer producers were the Windfall, Cedar Creek, and Meadow Creek properties.

Iron Mountain district.—Several lots of sulphide lead ore were shipped from the Iron Mountain mine, north of Superior.

Saltese district.—One lot of old tailings containing silver was shipped from the Last Chance mine.

MISSOULA COUNTY.

The placer output in 1920 from the Ninemile district was small, and some copper ore was shipped from the Copper Cliff district.

PARK COUNTY.

The value of the output of gold, silver, copper, and lead in Park County in 1920 increased $39,626, mostly from gold.

New World district (*Cooke*).—Considerable work was done in the New World district in 1920, but much of it was development work. Sulphide lead ore from the Great Republic group was shipped by autotrucks from Cooke to Gardner, a distance of 53 miles. At the Glengarry property work consisted of installing machinery and erecting buildings.

Sheepeater district (*Jardine*).—The Jardine Gold Mining & Milling Co. treated considerable ore by amalgamation and concentration. The sulphide concentrate contained arsenic as well as gold and silver. The 40-stamp mill was remodeled and new equipment installed.

POWELL COUNTY.

The value of the metal output of Powell County increased $16,473 in 1920.

Ontario district (*Elliston*).—Four deep mines in the Ontario district produced 1,232 tons of ore, containing $4,158 in gold, 5,842 ounces of silver, 11,484 pounds of copper, and 81,296 pounds of lead, valued in all at $19,143. Most of the output was copper-lead ore from the Monarch mine, treated in a 50-ton concentration mill. Several lots of sulphide lead ore, rich in gold, were shipped by the Evening Star Development Co.

Ophir district (*Finn*).—Sulphide lead ore was produced at the Julia mine and small lots of placer gold elsewhere in the Ophir district.

Pioneer district (*Gold Creek*).—Six placer mines in the Pioneer district produced $5,545 in gold and 39 ounces of silver. The Friday, Pioneer, and Orofino placers were the largest producers.

Unorganized district.—The North Pole mine, near Elliston, Mont., produced several lots of siliceous silver ore.

SANDERS COUNTY.

Several lots of sulphide copper ore were shipped from the Dixon, Iron Mask, and Copper King properties in Revais Creek and Thompson River districts.

SILVER BOW COUNTY.

Mine production in Silver Bow County, Mont., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine oz.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	87	3,907,089	$579,638	10,531,127	169,052,604	20,311,907	167,294,479	$57,107,312
1920	103	5,013,847	647,013	10,575,894	176,403,808	17,590,182	183,812,943	60,929,101
Increase or decrease, 1920	+16	+1,106,758	+67,375	+44,767	+7,351,204	−2,721,725	+16,518,464	+3,821,789

[a] Includes placer production.

Most of the output of Silver Bow County in 1920 was produced by 10 companies. An increase in output of all metals but lead is shown in the accompanying table. The largest part of the ore produced was concentrated at milling plants at Butte and Anaconda. The product consisted of copper concentrates, zinc concentrates, lead-zinc concentrates, lead concentrates, copper-lead-zinc concentrates, and siliceous concentrates, valued in all at $52,541,400, or $50.83 a ton. The crude smelting ore had an average value of $21.65 a ton. No ore was treated in gold and silver mills, but 42,910 tons of copper ore and 1,213,345 tons of old tailing were leached with sulphuric acid, and 413,471 tons of slimes or tailings were milled or smelted. Of the total output of ore about 80 per cent was classified as copper material.

Divide Creek district (Melrose).—Ten deep mines in the Divide Creek district produced 288 tons of ore, containing $581 in gold, 5,192 ounces of silver, 4,578 pounds of copper, and 1,190 pounds of lead, valued in all at $7,178. Most of the production came from the Gold Dust and Horn Silver properties, which produced siliceous silver ore.

German Gulch district.—The Beal placer was operated 42 days by hydraulic and sluicing methods.

Summit Valley or Butte district.—Eighty-nine deep mines in the Butte district produced 5,013,559 tons of ore and tailings, containing $643,595 in gold, 10,570,676 ounces of silver, 176,399,230 pounds of copper, 17,588,992 pounds of lead, and 183,812,943 pounds of recoverable zinc, valued in all at $60,919,057, or an average of $12.15 a ton. Most of the ore, 3,220,788 tons, was milled, and 123,045 tons was crude ore smelted.

Since the beginning of activities in 1882 to the end of 1920 Silver Bow County, of which this district covers the largest part, has produced gold, silver, copper, lead, and zinc valued at $1,681,170,169, divided as follows: Gold, $31,518,758; silver, $261,585,872; copper, $1,246,297,848; lead, $6,719,920; and zinc, $135,047,771. The production of zinc began in 1905. The values given above are for 1,524,719.88 ounces of gold, 360,724,875 ounces of silver, 7,939,074,474 pounds of copper, 104,813,342 pounds of lead, and 1,467,026,886 pounds of recoverable zinc.

The mines of the Anaconda Copper Mining Co.[5] produced 2,152,763 tons of ore and 7,557 tons of precipitates, a total of 2,160,320 tons in 1920, against a total of 2,113,519 tons in 1919. The copper reduction works treated for all companies 2,319,337 tons of ore and other cupriferous material at Anaconda. No copper ores were treated at Great Falls except a small quantity of copper concentrates from Anaconda used for the fluxing of zinc plant residues. Of the material treated at Anaconda 1,828,380 tons of ore was produced by company mines, 458,339 tons of ore was either purchased from or treated for other companies, and 32,618 tons was precipitates and cleanings from the old works at Anaconda and Butte. The Anaconda works produced 155,339,575 pounds of fine copper, 7,113,659 ounces of silver, and 32,530.30 ounces of gold, and a large part of this production came from the mines of the Anaconda Co. The electrolytic

[5] Anaconda Copper Mining Co. Ann. Rept. for year ending Dec. 31, 1920.

copper refinery at Great Falls produced 145,149,892 pounds of cathodes, which were melted into shapes at Great Falls. The copper-leaching plant at Anaconda treated 484,353 tons of tailings and 43,272 tons of purchased ore, from which 5,037 tons of cement copper was produced. The copper concentrator also treated by flotation 181,034 tons of slimes from the ponds and 722,770 tons of tailings. The zinc plants at Anaconda and Great Falls treated 443,582 tons of ore and other zinciferous material, of which 310,572 tons was produced by mines of the Anaconda Co., and 133,010 tons of ore and concentrates was purchased from other companies. The plant at Great Falls produced 101,332,458 pounds of electrolytic zinc, 5,255,452 pounds of zinc in dross, and residue which contained 12,536,088 pounds of lead, 2,173,080 pounds of copper, 2,073,349 ounces of silver, and 6,150.96 ounces of gold. Of the copper output 74,596,787 pounds was rolled into rods, of which 22,326,478 pounds was made into wire and 5,292,604 pounds was made into strand. Dividends paid in 1920 by the Anaconda Co. amounted to $6,993,750. The company report continues:

The year opened with a strong demand for both copper and zinc, a broad buying movement which began in November, 1919, extending into February, and sales of metals covering deliveries to the end of the second quarter at fair prices seemed to promise a recovery from the general depression. * * *

The buying of metals ceased during the first quarter and deliveries after August were at a rate below production, until during the last quarter the collapse in general business and industry, both domestic and foreign, brought business almost to a standstill. * * *

The reduced rate of production resulted in excessive costs. * * *

The income for the year after payment of all direct expenses was $9,335,253.18, and after deduction for interest paid and depreciation reserve the net income was $2,961,660.62. * * *

The operation of the company's mines was curtailed throughout the entire year, but notwithstanding this fact an amount of development work greater than that done the previous year was carried on. * * *

Development consisted of 22.55 miles of work.

From the North Butte property[6] 312,982 dry tons of ore and 15 dry tons of precipitates were treated at the smelter at Anaconda. Of this ore, 309,447 tons, or 98.9 per cent, was second class, and 3,535 dry tons, or 1.1 per cent was third class. The production was 16,576,510 pounds of fine copper, 693,633 ounces of silver, and 1,004 ounces of gold. The Bertha mine produced 2,235 tons of ore containing 90,309 pounds of copper. The report continues as follows:

The cost of production was 17.6378 cents per pound, including all expenses and depreciation, but not ore depletion, and deducting value of silver and gold. * * *

Production was maintained at about the rate of the previous year, averaging 1,036 tons hoisted per day as compared with 1,011 in 1919. Practically all of this was mined through the Granite Mountain shaft. * * * At the Speculator shaft, various sections above the 1,200 level, where there is heavy ground, were concreted, completing work that had been commenced the year before. * * *

Development work was maintained on a scale in keeping with rate of production. At the Granite Mountain mine 19,100 feet of work was done in drifts, raises, and crosscuts. * * *

At the East Side properties considerable additional work was done on the 700 and 900 levels of the Sarsfield mine. The results added considerable useful information on the geology of the area explored, and disclosed some copper

[6] North Butte Mining Co. Ann. Rept. for year ending Dec. 31, 1920.

veins, although none of them, as far as developed, carried values sufficient to constitute commercial ore. At the Bertha mine on the 100 level there was disclosed a considerable body of siliceous ore averaging 2.3 per cent copper. * * *

The year's operations showed a deficit due entirely to the drop in metal prices, thereby causing a large shrinkage in the value of copper and silver carried over from the previous year. Wage rates in force throughout the year, as well as average prices of supplies, were the highest in the history of the industry. * * *

Gross income was $3,101,404 and expenditures $3,667,638, including $2,506,649 for mining and development, $53,153 for freight, and $997,669 for concentrating, smelting, refining, and selling.

The East Butte Copper Mining Co.[7] operated the 500-ton copper smelter and 1,200-ton concentration-flotation plant east of Butte. The mine and smelter were in operation full time. The mill and smelter treated 111,969 tons of company ore and 87,545 tons of custom ore, producing 867 ounces of gold, 690,488 ounces of silver, and 18,534,270 pounds of copper, a decrease in the copper output of more than 7 per cent from that of 1919. The gross value of the metals shipped was $3,241,813. No dividends were paid in 1920. The price received for copper was 17.456 cents a pound, and the cost of production was 15.8545 cents a pound. The report continues:

The operating statement shows a net deficit amounting to $68,161.90. * * * It arises largely from two sources: First, there are carried on hand in the process of manufacture approximately 10,000,000 pounds of copper. * * * Secondly, the deficit is due to unusually heavy expenditures in outside exploration, namely, exploration for oil. These amounted to $276,798. * * *

Exploration and development work during the year 1920 amounted to 6,829 feet of drifting and crosscutting and 1,468 feet of upraising. As a result of this work there was developed ore that is estimated at 25,000 tons of first-class, averaging 7.0 per cent in copper content, and 70,000 tons of second-class, averaging 3.5 per cent. * * *

The Tuolumne Copper Mining Co.[8] produced from the Main Range mine in 350 operating days 27,952 dry tons of ore which had an average assay of 0.0075 ounce of gold, 9.949 ounces of silver, and 2.026 per cent of copper. The total metal contents were 210.58 ounces of gold, 278,115 ounces of silver, and 1,132,977 pounds of copper, for which the company received $265,332 from the smelter. The printed report continues:

The total operating expense for the year amounted to $258,994.21, or $8.48 per ton of wet ore produced. Of this amount $155,688.55, or $5.10 per ton of wet ore, was charged to cost of mining, $45,855.37 was charged to development work, and $11,010.08 to underground repairs and alterations. * * *

During the year 2,174 feet of development work was done. * * *

The development of the Spread Delight vein on the 1,200-foot level is far from complete but with the limited amount of work that has been done thus far a very material improvement in the size of the vein, its mineralization, and width of ore shoots is found as compared with the development of this vein on the 1,000-foot level. * * *

The Butte & Superior Mining Co.[9] produced 334,919 tons of milling ore, a decrease from the output of 1919. The mill recoveries for the year averaged 94.975 per cent of the zinc contents. The revenue from the sale of concentrates and residues was $4,460,547. Freight

[7] East Butte Copper Mining Co. Ann. Rept. for year ending Dec. 31, 1920.
[8] Tuolumne Copper Mining Co. Ann. Rept. for year ending Dec. 31, 1920.
[9] Butte & Superior Mining Co. Ninth Ann. Rept., for year ending Dec. 31, 1920.

cost $681,271, mining $2,260,487, milling $1,020,045. The net income after deduction for taxes, depletion, etc., was $187,929. The report continues:

The tonnage treated in 1920 was considerably less than that for 1919 and the grade of ore lower. Output and earnings shrunk correspondingly on this account. As shown by the quarterly reports issued during the year, approximately 40 per cent of the year's tonnage was mined and treated in the first quarter; the profits resulting from this quarter being sufficient to a little more than offset the losses sustained in subsequent quarters.

The average price of zinc under which settlements were made for the year was 7.907 cents, as compared with 7.1446 cents for 1919, an increase of 0.763 cent, this increase over the previous year being due to the large proportion of sales made in the first quarter at an average of 8.5 cents, which average was in excess of the average price of zinc for the year 1919. The price of zinc, however, declined steadily through the year 1920 from a peak of 9.133 cents in January to a low of 5.824 cents in December. As stated in the report for the fourth quarter, the price of zinc fell so low that it was decided to entirely discontinue operations on November 10. * * *

The estimate of developed ore reserves as of December 31, 1920, shows 422,100 tons, as compared with the estimate of 623,300 tons as of December 31, 1919. * * *

Development work during the year consisted of 16,981 feet, exclusive of diamond drilling which amounted to 856 feet. * * *

The direct cost of mining for the year was $6.75 per ton, as compared with $6.30 for the previous year, or an increase of 45 cents per ton. * * *

Crude ore treated and concentrates produced at Butte-Superior mill in 1920.

Ore and product.	Ore	Gold.		Silver.	
		Total content.	Average per ton.	Total content.	Average per ton.
	Short tons.	*Ounces.*	*Ounce.*	*Ounces.*	*Ounces.*
Crude ore, milled	334,919	3,349.190	0.0100	1,812,552	5.4119
Zinc concentrate	81,836	2,805.531	.0343	1,595,319	19.4940
Lead concentrate	1,150	47.884	.0416	22,558	19.6210

Ore and product.	Copper.		Lead.		Zinc.	
	Total content.	Average per ton.	Total content.	Average per ton.	Total content.	Average per ton.
	Pounds.	*Per cent.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
Crude ore, milled	884,039	0.132	7,660,226	1.144	91,642,260	13.6813
Zinc concentrate	722,745	.442	6,257,506	3.823	87,037,776	53.1872
Lead concentrate	4,368	.190	940,580	40.905	221,695	9.6410

The Emma mine,[10] owned by the Butte Copper & Zinc Co., and leased to the Anaconda Copper Mining Co., was active most of the year. Lead-zinc ore was shipped to Anaconda for milling, and concentrates were roasted and leached at Great Falls. Manganese ore was shipped to an eastern steel plant and to the ferromanganese plant at Great Falls. The report continues:

In the report for 1919 mention was made of the possibility of running a crosscut from the bottom of the Ophir shaft, making connection eventually with the Emma workings. The plans were changed, however, and the crosscut was started on the 1,000-foot level of the Emma mine and driven toward

[10] Butte Copper & Zinc Co. Fourth Ann. Rept., for year ending Dec. 31, 1920.

the Ophir workings. This crosscut has now attained a length of 1,763 feet from the Emma shaft. * * *

Bodies of commercial zinc ore were disclosed by the drifts on the 600, 900, and 1,000 foot levels, the ore body on the east end of the 1,000-foot level being of exceptional width and grade. * * *

The Elm Orlu mine was active the entire year and greatly increased its output, especially of silver and zinc. Lead-zinc ore was milled at the Timber Butte mill, south of Butte, and copper ore was shipped to Anaconda. Zinc concentrate at the rate of more than 5,000 tons a month was shipped to eastern zinc smelters and to the electrolytic zinc plant at Great Falls, and lead concentrate was smelted at East Helena. The Moulton, Poser, and Anselmo mines and the tailing dump of the Butte Reduction Works, also controlled by the Clark interests, were active in 1920 and produced silver ore, lead-zinc ore, and copper concentrate. In December the Timber Butte mill was closed as a result of the decline in the price of zinc.

The Davis-Daly Copper Co. operated the Colorado mine, in the center of the city of Butte, and the Hibernia mine, 2 miles west of Butte. A summary of the quarterly reports of the company gave the following information: The Colorado mine produced 84,211 tons of copper ore, containing 429,418 ounces of silver and 10,058,762 pounds of copper, or an average of about 5.97 per cent of copper. A dividend of $150,000 was paid in March. Development work, including that in the Hibernia mine, consisted of 4,689 feet of drifts, 4,741 feet of crosscuts, and 4,436 feet of raises. Receipts from ore sold amounted to $1,356,742, and total disbursements were $1,266,484. The Hibernia mine produced about 2,000 tons of silver ore a month, as well as lead-zinc ore, which was milled. The shaft is driven to the 600-foot level. Many surface improvements were made at the Colorado mine, and a new air shaft was nearly completed during the year.

Copper ore was leached at Anaconda from the Bullwhacker and Butte & Duluth mines, and milling ore was shipped from the Arctic and Butte Ramsdall mines. Much silver ore was shipped from the Crystal, Salvador, Ottawa, Amy, Venus, Butte New England, and Butte Metals mines.

ZINC.

(GENERAL REPORT.)

By C. E. Siebenthal and A. Stoll.

SUMMARY.

Zinc produced and consumed in the United States, 1919–20, in short tons.

	1919	1920
Production of primary zinc: [a]		
From domestic ore	452,272	450,045
From foreign ore	13,471	13,332
	465,743	463,377
Production of secondary zinc: [a]		
Redistilled	19,748	21,371
Remelted	20,162	21,479
	505,653	506,227
Apparent consumption of primary zinc	323,964	323,043

[a] "Primary zinc," which is produced directly from ore, is here distinguished from "secondary zinc," which is obtained by refining zinc ashes, skimmings, drosses, and old metals. The statistics of secondary zinc are given on page 224. Wherever in this report the word "zinc" is used without qualification it means primary zinc.

INTRODUCTION.

Owing to necessary economies in Government printing it has been deemed advisable to eliminate the notes which have heretofore been published explanatory of the tables in these reports. The reader will find the full notes in the chapter on zinc in Mineral Resources for 1918. For the same reason the period covered by the tables has, with a few exceptions, been limited to the years 1914–1920, and some tables have been omitted.

PRODUCTION.

The smelting of zinc in the United States began in an experimental way in 1858, and regular production began in 1860 at the Lehigh Zinc Works in the East and at the Matthiessen & Hegeler Works in the West. Annual statistics have been collected by the United States Geological Survey since 1882, and the progress of the zinc-smelting industry has been fully recorded in these reports.

PRIMARY ZINC.

Primary zinc[a] produced in the United States, 1914–1920, in short tons.

Apportioned according to source of ore.

	1914	1915	1916	1917	1918	1919	1920
Total domestic	343,418	458,135	564,338	584,597	492,405	452,272	450,045
Foreign:							
Canada	4,538	5,103	24,376	6,787	8,700	4,007	1,583
Mexico	5,093	13,943	20,694	40,360	14,043	8,083	8,978
South America			6		886	751	536
Europe		1,073	12,714	11,689	113		
Africa			2,352				
Asia		1,030	1,905				
Australia		10,235	41,958	26,140	1,780	630	2,235
Total foreign	9,631	31,384	104,005	84,976	25,522	13,471	13,332
Total primary	353,049	489,519	668,343	669,573	517,927	465,743	463,377

Apportioned according to locality at which reduced.

Arkansas			7,503	25,660	26,753	31,437	31,481
Illinois	127,946	159,958	181,433	172,489	141,844	118,458	109,056
Kansas	44,510	101,423	141,286	76,048	29,149	43,942	41,044
Oklahoma	91,367	109,208	168,206	204,394	139,066	121,988	110,500
Pennsylvania	28,095	44,167	76,545	86,995	77,342	67,521	74,234
Other States	61,131	74,763	93,370	103,987	103,773	82,397	97,062
	353,049	489,519	668,343	669,573	517,927	465,743	463,377

[a] Primary zinc is made directly from ore; secondary zinc is recovered from drosses, galvanizers' ashes, old metal, and like sources.

DISTILLED AND ELECTROLYTIC ZINC.

Selected secondary zinc materials, such as zinc ashes and scrap, carefully redistilled, yield zinc of all grades, which enters the market for practically all purposes. Considerable secondary material is mixed with ore and used by some regular ore smelters. Though the quantity of metal so derived can be calculated by the smelters and thus eliminated from the output of primary zinc, it is practically impossible to segregate the redistilled secondary zinc by grades or in smelter stocks. Hence the smelter stocks as given contain some secondary zinc, and the statistics of production of zinc by grades as given in the table below likewise include secondary zinc. The quantity of secondary zinc included in the graded zinc is given in the first part of the table, which gives the source of the graded zinc by the methods of reduction.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1914–1920, in short tons.

Apportioned according to method of reduction.

	1914	1915	1916	1917	1918	1919	1920
Electrolytic		252	[a] 11,116	[a] 25,209	[a] 38,916	27,056	51,626
Distilled primary	353,049	489,267	657,227	644,364	479,011	438,687	411,751
Redistilled secondary zinc [b]	20,545	29,764	28,776	16,835	9,918	19,748	21,371
	373,594	519,283	697,119	686,408	527,845	485,491	484,748

[a] Prime western zinc refined by electrolysis in addition: In 1916, 1,800 tons; in 1917, 1,701 tons; in 1918 753 tons.

[b] For total production of secondary zinc see p. 224.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1914–1920, in short tons—Continued.

Apportioned according to grade.

	1914	1915	1916	1917	1918	1919	1920
Grade A (high grade, 1914–1916)	19,385	54,056	73,405	97,707	129,344	45,377	80,713
Grade B (intermediate, 1914–1916)	32,076	69,751	94,825	69,189	68,987	39,173	33,893
Grade C (select and brass special, 1914–1916)	68,551	93,131	100,875	148,749	98,584	140,917	59,811
Grade D (prime western)	253,582	302,345	428,014	370,763	230,930	260,024	310,331
	373,594	519,283	697,119	686,408	527,845	485,491	484,748

ROLLED ZINC.

The production of rolled zinc in the United States declined about 2 per cent in quantity but increased 7 per cent in value in 1920, as compared with 1919. The loss in quantity was greatest in boiler plates and heavy sheets, amounting to 22 per cent, and there was also a loss in the quantity of zinc strips but a slight gain in ordinary zinc sheets.

The table below includes the exports as shown by the records of the Bureau of Foreign and Domestic Commerce. If the figures showing the exports are deducted from those showing the production, the result will approximate the domestic consumption.

Zinc rolled in the United States, 1919–1920.

	1919	1920
Zinc sheets:		
Quantity ..... pounds..	56,514,868	56,812,989
Value	$6,023,773	$6,625,660
Average price per pound	$0.107	$0.117
Boiler plates and special sheets:		
Quantity ..... pounds..	5,083,137	3,950,489
Value	$521,389	$402,035
Average price per pound	$0.103	$0.102
Zinc strips:		
Quantity ..... pounds..	46,995,742	45,704,052
Value	$4,902,407	$5,262,538
Average price per pound	$0.104	$0.115
Total rolled zinc:		
Quantity ..... pounds..	108,593,747	106,467,530
Value	$11,447,569	$12,290,233
Average price per pound	$0.105	$0.115
Rolled zinc exported:		
Quantity ..... pounds..	39,524,516	23,704,197
Value	$5,212,002	$2,832,993
Average price per pound	$0.132	$0.120
Apparent consumption of rolled zinc ..... pounds..	69,069,231	82,763,333

ZINC DUST.

Zinc dust has been prepared and marketed by domestic smelters since 1910.

Zinc dust produced in the United States, 1914–1920.

Year.	Prepared "blue powder."			Zinc dust "atomized."		
	Quantity (short tons).	Value.[a]	Average selling price per pound.	Quantity (short tons).	Value.[a]	Average selling price per pound.
1914	1,004	$184,736	$0.092	.....	.....	.....
1915	1,755	940,680	.268	.....	.....	.....
1916	2,548	1,097,397	.215	61	$26,230	$0.215
1917	3,989	1,322,196	.166	1,924	642,782	.167
1918	4,016	877,171	.109	2,979	773,746	.130
1919	[b] 4,083	801,366	.098	[b] 2,515	524,694	.104
1920	[b] 9,066	2,009,117	.111	[b] 2,273	512,833	.113

[a] Value is calculated from the total value of material sold during year.
[b] Of the total output of zinc dust in 1919, 385 tons of "blue powder" and 676 tons of "atomized" zinc dust was made from secondary zinc materials. In 1920, 1,179 tons of zinc dust was made from secondary materials.

ZINC PIGMENTS.

Zinc forms the base, either in whole or in part, of four white pigments—zinc oxide, leaded zinc oxide, zinc-lead oxide, and lithopone.

Details of the production of zinc pigments and of market conditions are given in the chapter on lead and zinc pigments and salts.

The zinc content of the pigments made in the United States from ore, both domestic and foreign, for the period 1914–1920 is given in the table below. Statistics of the secondary zinc recovered in the form of pigments are given under the next heading.

Primary zinc content of zinc pigments made in the United States, 1914–1920, in short tons.

1914	70,619	1918	102,778
1915	79,572	1919	96,817
1916	90,276	1920	110,695
1917	97,573		

SECONDARY ZINC.

In the table below the secondary zinc [1] recovered by redistillation is separated from that recovered by remelting. The canvass of secondary smelters was made by J. P. Dunlop, of the United States Geological Survey.

Secondary zinc produced in the United States, 1915–1920, in short tons.

	1915	1916	1917	1918	1919	1920
Secondary zinc, redistilled	29,764	28,776	16,835	9,918	19,748	21,371
Secondary zinc, remelted	23,136	21,037	14,565	17,190	20,162	21,479
Recovered zinc in alloys, excluding old brass remelted	5,300	2,600	4,800	11,082	6,062	7,650
Recovered zinc in remelted brass	34,375	61,700	80,000	82,400	62,400	65,000
Secondary zinc recovered as metal	92,575	114,100	116,200	120,600	108,400	115,500
Secondary zinc recovered in zinc dust	.....	.....	.....	.....	955	1,061
Secondary zinc recovered in pigments	8,323	8,749	9,204	8,675	10,702	12,870
Secondary zinc recovered in zinc chloride [a]	7,860	6,319	6,248	7,348	10,273	11,546
Total secondary zinc	108,758	129,200	132,000	137,000	130,300	141,000

[a] These figures include only the quantity of zinc chloride used in wood preservation and were furnished by courtesy of the Forest Service, Department of Agriculture. They may include some imported zinc chloride. In the last few years some zinc chloride has been made from primary material. (See chapter on lead and zinc pigments and salts.)

[1] See page 221 for definition of secondary zinc.

BY-PRODUCT SULPHURIC ACID.

An important by-product of zinc-smelting operations is the sulphuric acid made from the sulphur gases evolved in roasting the zinc sulphide ores preparatory to their distillation or conversion to zinc oxide or to zinc salts. Sulphur gases from zinc ores were first thus utilized by Matthiessen & Hegeler, at La Salle, Ill., in 1882, but now there are 20 acid plants using these gases. These acid plants may be located at zinc smelters, at roasting and magnetic separating plants, at the mines, or nearer the acid markets, the roasted concentrates being shipped to the smelters or to other zinc plants. Figures of output of this by-product acid have been collected by the Survey for a number of years, but in 1918 it was found that so many governmental or other agencies were collecting figures for acid that the Survey stopped doing so in order to relieve producers of a part of the labor of making reports. This decision is to be regretted, as it broke the continuity of the record and left only an estimate of production available for 1918. Figures for 1919 were obtained by the Census Bureau, but the Survey again undertook their collection for 1920.

In the last two or three years the demand for sulphuric acid has been stronger than that for zinc, so that considerable quantities of sulphur have been burned in order to utilize the full capacity of the acid plants. This acid made from sulphur has not been distinguished in the table of output given below.

By-product sulphuric acid made from zinc-bearing ores, 1914–1920.

Year.	Number of companies operating.	Number of acid plants operated.	Acid produced.					
			50°–66° Baumé.			Higher strengths.		
			Equivalent quantity in 60° Baumé (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.
1914	11	15	[a] 411,911	$2,974,603	$7.22	.....	.....	.....
1915	12	16	[a] 484,942	4,292,493	8.85	59,189	$579,115	$9.78
1916	11	17	[a] 671,585	8,169,651	12.16	92,802	1,941,661	20.92
1917	15	21	[a] 908,563	11,261,142	12.39	119,048	2,374,441	19.94
1918	[b]	[b]	[c] 900,000	[b]	[b]	[b]	[b]	[b]
1919 [d]	10	14	[d] 517,922	[d] 6,360,879	[d] 12.28	[d]	[d]	[d]
1920	13	20	790,510	10,674,481	13.50	36,907	754,278	20.44

[a] Reported as 50°, 60°, and 66° Baumé and higher strengths, the three strengths, specifically mentioned being converted to 60° Baumé on the basis of H_2SO_4 content; 50° Baumé equals 62.53 per cent H_2SO_4; 60° Baumé equals 78.04 per cent H_2SO_4; and 66° Baumé equals 96 per cent H_2SO_4 (Lunge's Tables).

[b] Not available.

[c] Estimated by H. L. Lewenberg (Price of mineral acids; War Industries Board Bull. 45, pp. 3–18, 1919).

[d] As reported by the Bureau of the Census. Acid of "higher strengths" included with acid of 50°–66° Baumé.

Zinc-bearing sulphide ores from which sulphuric acid was made, 1914–1920, in short tons.

Year.	Domestic.	Foreign.	Total.
1914	[a] 424,714	(a)	424,714
1915	363,879	19,697	383,576
1916	595,420	103,042	698,462
1917	654,192	171,148	825,340
1918	(b)	(b)	(b)
1919	(b)	(b)	(b)
1920	475,000	2,190	477,000

[a] A few thousand tons of foreign ore is included under domestic. [b] Not available.

MINE PRODUCTION.

The preceding tables give the quantity of zinc recovered either as metal by smelting and by electrolytic reduction, or in zinc dust, or as zinc in pigments. The following table shows the origin of the domestic zinc that is recovered by metallurgic operations. The origin of the zinc by States is obtained more accurately from the mines reports, because smelters necessarily treat mixtures of ores, sometimes long after they have been received, so that the actual output of metallic zinc may not correspond at all closely to the product of the mines for the same year. The data for the tables of mine production are taken from the mines reports on gold, silver, copper, lead, and zinc in the different States, as indicated in the prefatory note.

Mine production of zinc in the United States, 1914–1920, in short tons.

State.	1914	1915	1916	1917	1918	1919	1920
Arizona	4,896	9,110	9,839	10,447	1,135	859	729
Arkansas	608	3,209	6,815	6,691	951	189	329
California	195	6,547	7,628	5,436	2,781	236	583
Colorado	48,387	52,297	67,143	60,158	44,567	18,610	24,395
Idaho	21,006	35,077	43,253	39,927	22,581	7,997	13,966
Illinois	4,811	5,534	3,404	4,267	3,792	6,788	4,720
Iowa			21	18			
Kansas	11,284	14,365	12,448	20,249	30,197	47,636	61,073
Kentucky	230	764	1,096	751	315	36	9
Missouri	105,994	136,300	155,960	132,918	55,992	31,540	24,509
Montana	55,790	93,573	114,630	93,130	104,629	84,382	92,169
Nevada	6,490	12,188	16,222	11,154	8,362	4,502	5,349
New Hampshire	6	24	36	45	14		
New Jersey	82,956	117,722	112,020	120,846	98,470	92,912	77,371
New Mexico	9,202	12,702	18,285	15,100	12,025	3,797	5,007
New York		2,455	4,507	5,192	3,776	5,120	5,654
Oklahoma	13,992	14,314	28,754	85,835	161,401	178,410	219,727
Tennessee	10,425	16,461	26,428	28,498	21,071	23,247	19,217
Texas	108	15	116	11			
Utah	7,995	12,146	14,786	10,643	9,200	2,216	4,079
Virginia	174	1,267	2,276	1,703	951		
Washington		122	847	598	19		213
Wisconsin	31,113	41,403	56,803	59,742	50,014	40,765	27,285
	415,662	587,595	703,317	713,359	632,243	549,242	586,384

COMPARISON OF PRODUCTION BASED ON SMELTER AND ON MINE REPORTS.

The figures of the smelter production of domestic primary zinc are given in the foregoing pages. The mine figures are the totals for all the States as given in part above. In order to put the smelter figures on a basis comparable with the mine figures all the zinc manufactured directly from domestic ore into pigments and in 1919 and since into zinc salts is added to the metallic zinc production. The zinc content of zinc dust ("blue powder") and of such "atomized" zinc dust as is made from metallic zinc not already taken into statistical account is also included with the metallic zinc. The zinc recovered from secondary sources is excluded, for it has already been once reckoned as zinc. Likewise the zinc in zinc oxide made from metallic zinc and the zinc content of "atomized" zinc dust made from metallic zinc already counted have been left out, as their inclusion would entail a duplication to that extent. These facts must be borne in mind in comparing the smelter totals of the subjoined table with previous tables showing the smelter production of zinc.

Domestic zinc produced by smelters and by mines, 1907–1920, in short tons.

Year.	Totals compiled from smelter reports.	Totals compiled from mine reports.	Smelter excess.	Mine excess.
1907–1913	2,215,119	2,260,772	25,668	71,321
1914	424,672	415,662	9,010	.....
1915	539,074	587,595	.....	48,521
1916	656,875	703,317	.....	46,442
1917	684,872	713,359	.....	28,487
1918	597,747	632,243	.....	34,496
1919	553,833	549,242	4,591	.....
1920	565,441	586,384	.....	20,943
	6,237,633	6,448,574	.....	210,941

ZINC-REDUCTION PLANTS.

SMELTERS.

Zinc-smelting plants operating in 1920.

Plants with ordinary retorts.

Operating company.	Location of plant.	Number of retorts.
ARKANSAS.		
Arkansas Zinc & Smelting Corporation	Van Buren	3,200
Athletic Mining & Smelting Co	Fort Smith	2,496
Fort Smith Spelter Co	....do	2,560
COLORADO.		
United States Zinc Co	Pueblo	1,805
ILLINOIS.		
American Zinc Co. of Illinois	Hillsboro	4,860
Do	East St. Louis	5,620
Eagle-Picher Lead Co	Hillsboro	3,200
Hegeler Zinc Co	Danville	5,400
Illinois Zinc Co	Peru	5,520
Matthiessen & Hegeler Zinc Co	La Salle	6,132
Mineral Point Zinc Co	Depue	9,068
Missouri Zinc Co	Beckemeyer	352
Sandoval Zinc Co	Sandoval	672
INDIANA.		
Grasselli Chemical Co	Terre Haute	4,200
KANSAS.		
Edgar Zinc Co	Cherryvale	4,984
Prime Western Spelter Co	Iola	2,360
Weir Smelting Co	Caney	5,568
OKLAHOMA.		
Bartlesville Zinc Co	Bartlesville	5,184
Do	Blackwell	9,600
Bartlesville Zinc Co. (Lanyon-Starr plant)	Bartlesville	3,456
Eagle-Picher Lead Co	Henryetta	4,000
National Zinc Co	Bartlesville	4,256
Quinton Spelter Co	Quinton	2,016
Tulsa Fuel & Manufacturing Co	Collinsville	6,232
United States Zinc Co	Kusa	3,760
Do	Henryetta	3,448
Do	Sand Springs	6,700
Victory Metal Co	Henryetta	3,000
PENNSYLVANIA.		
American Steel & Wire Co	Donora	8,512
American Zinc & Chemical Co	Langeloth	7,296
New Jersey Zinc Co. (of Pennsylvania)	Palmerton	7,200

Zinc-smelting plants operating in 1920—Continued.

Plants with ordinary retorts—Continued.

Operating company.	Location of plant.	Number of retorts.
WEST VIRGINIA.		
Grasselli Chemical Co	Clarksburg	5,760
Do	Meadowbrook	8,400
United Zinc Smelting Corporation	Moundsville	1,728
		158,545

Plants with large retorts.

Trenton Smelting & Refining Co	Trenton, N. J	80

ELECTROLYTIC ZINC PLANTS.

Electrolytic zinc plants operating in 1920.

Operating company.	Location of plant.	Number of cells.
Anaconda Copper Mining Co	Great Falls, Mont	864
Illinois Zinc Co	Peru, Ill	
Judge Mining & Smelting Co	Park City, Utah	120

ZINC-SMELTING CAPACITY AND CHANGES IN 1920.

The number of retorts at zinc smelters at the end of 1920 was 158,545 at 34 plants in operation some time during the year. The number of retorts in operation at the end of 1920 was 56,200 at 23 plants, compared with 95,000 retorts in operation in June and with 107,500 retorts in operation at the end of 1919.

Few changes in capacity were made in 1920. The United States Zinc Co. changed one block of furnaces at Pueblo, Colo., to an oxide furnace. The same company took over the Kusa Spelter Co., at Kusa, Okla., in July. The Prime Western Spelter Co. disposed of the plant at Iola, Kans., in November. The American Metal Co. took over the Arkansas Zinc & Smelting Corporation. The United Zinc Smelting Corporation reported 1,208 retorts as under construction.

At the end of the year the following plants having 38,121 retorts were idle:

Arkansas Zinc & Smelting Corporation, Van Buren, Ark.
Bartlesville Zinc Co., Lanyon-Starr plant, Bartlesville, Okla.
Grasselli Chemical Co., Terre Haute, Ind.
Illinois Zinc Co., Peru, Ill.
Prime Western Spelter Co., Iola, Kans.
Sandoval Zinc Co., Sandoval, Ill.
United States Zinc Co., Pueblo, Colo.
Kusa, Okla.
Henryetta, Okla.
Sand Springs, Okla.
Victory Metal Co., Henryetta, Okla.

TRADE CONDITIONS.

WORLD'S PRODUCTION.

Owing to the disturbed conditions in Europe complete figures of the world's production of zinc are not available.

The following statistics, though incomplete, show approximately the foreign production during the war. The figures in black-faced type are taken from the official statistics of the countries named; those in the ordinary type are taken from statistical handbooks, consular reports, market letters, and trade journals. There is always a possibility of duplication in figures showing European production, for some countries send crude zinc of poor quality to other countries for refining. Furthermore, secondary zinc is included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in its production the domestic output of secondary zinc.

World's production of zinc, 1913–1920.

[In metric tons, by countries where smelted.]

Country.	1913	1914	1915	1916	1917	1918	1919	1920
Australia:								
Tasmania					**49**	**3,883**	**3,727**	**5,911**
Mainland	**4,187**	**5,094**	**5,393**	**5,362**	**4,769**	**5,712**	**3,625**	**3,909**
Austria	21,707	15,068	9,472	11,642	12,633	12,012	(*a*)	(*a*)
Belgium	**204,220**	**145,925**	**51,660**	**22,930**	**10,290**	**9,245**	**19,860**	**84,260**
Canada			20	**2,698**	**9,058**	**11,139**	**11,182**	**16,798**
China	(*a*)	(*a*)	(*a*)	(*a*)	(*a*)	(*a*)	(*a*)	(*a*)
France	**67,890**	**42,473**	**19,180**	**20,258**	**22,929**	**18,347**	**10,800**	(*a*)
Germany:								
Upper Silesia	**169,439**	**141,761**	**121,851**	**122,489**	**128,832**	**122,961**	**74,023**	[b]**45,036**
Other Germany	113,674	94,000	65,000	55,000	57,000	53,000	(*a*)	(*a*)
Great Britain	66,243	50,000	45,000	60,000	50,000	50,000	35,000	(*a*)
Italy				**258**	**367**	**1,188**	**1,282**	(*a*)
Japan	900	**5,913**	**21,131**	**38,994**	**54,718**	39,915	**19,816**	(*a*)
Netherlands	**24,323**	**16,453**	**11,130**	**12,101**	**4,059**	**681**	.....	**2,031**
Norway	9,287	18,995	24,993	31,991	21,993	20,000	3,400	(*a*)
Russia	**10,500**	**6,300**	**2,000**	**1,100**	(*a*)	(*a*)	2,500	(*a*)
Siberia				**213**	**569**	(*a*)	(*a*)	(*a*)
Spain	**6,003**	**11,733**	**8,117**	8,523	**10,155**	**15,900**	**16,314**	(*a*)
Sweden	**2,115**	**2,300**	**8,588**	**9,997**	**7,979**	**4,098**	**2,321**	(*a*)
United States	**314,498**	**320,279**	**444,082**	**606,307**	**607,423**	**469,853**	**422,513**	**420,366**
Known output	1,015,000	876,000	838,000	1,010,000	1,003,000	838,000	627,000	.....

[a] Statistics not available. [b] January to June only.

The following table shows the output of zinc ore by different countries in the last four years and in 1913 for comparison with prewar conditions. The zinc content is estimated where possible, but often that information is not given. Official reports for 1920 were mostly lacking at the time the table was prepared:

World's production of zinc ore and concentrates with estimated zinc content, 1913 and 1917–1920, in metric tons.

[Blank spaces indicate that statistics are unavailable.]

Country.	1913		1917		1918		1919		1920	
	Ore.	Zinc content.	Ore.	Zinc content.	Ore.	Zinc content.	Ore.	Zinc content.	Ore.	Zinc content.
North America:										
Canada	7,157	3,207	105,676	29,327	109,950	28,588	122,955	27,197	224,154	40,464
Mexico (United Statesimports)	15,853	5,588	131,867	41,456	48,396	16,716	30,339	10,183	42,369	14,975
United States (recoverable zinc)		374,965		647,145		573,558		498,261		530,493
South America:										
Argentina			453							
Bolivia	7,367		427							
Peru	22	11								
Europe:										
Austria	16,373		2,684							
Belgium	949		231		17					
France	46,577		38,125	5,364	25,087	6,603	24,297		4,246	
Germany—										
Upper Silesia	508,000	185,000	438,000	167,000	373,000	141,000	237,671	89,000		
Other Germany	142,000	58,000	124,000	51,000	116,000	48,000	75,000	31,000		
Greece	36,402		14,290	3,751	4,342					
Italy—										
Zinc ore	158,278	63,723	79,453	45,005	67,116	29,471	65,629	26,901	98,090	
Zinc-lead ore	504	71	800	48	800	48	3,915	560		
Norway	897	197	269	59	268					
Russia—										
Poland							67,119			
Caucasus		12,000								
Spain	171,831	56,723	123,486	36,115	109,030	31,121	103,608	29,902		
Sweden	50,752	18,203	51,312	17,365	48,507	16,960	49,451	17,446		
United Kingdom	17,572	5,916	7,604	2,779	9,170	3,297	7,044	2,475	5,145	1,800
Asia:										
British India	3,933									
China	9,547		228		166		2			
Indo-China	33,430		24,904		28,650					
Japan	34,719		163		50,369		34,710			
Siberia		9,000								
Africa:										
Algeria	82,000		42,407		17,940	7,890	13,329	5,332	26,422	10,500
Egypt	3,159									
Tunis	30,300		14,853		6,022		6,185			
Oceania:										
Australia	514,793	241,953	115,402	55,000	92,299	44,000	73,744	35,000		

IMPORTS AND EXPORTS.

The following tables of imports and exports of zinc and of zinc remaining in warehouses are made up from the publications and records of the Bureau of Foreign and Domestic Commerce of the Department of Commerce.

ZINC REMAINING IN WAREHOUSE.

Zinc remaining in warehouse in the United States, Dec. 31, 1914–1920.

Year.	Ore and calamine.			Blocks, pigs, and old.		Zinc dust.	
	Quantity (short tons).	Zinc content (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
1914	6,728	6,987,676	$90,257	221,994	$11,100	272,915	$13,005
1915	63,168	43,691,611	1,628,509	63,892	4,028	115,375	8,815
1916	82,227	57,259,940	2,210,286	180,026	14,301	120,921	12,989
1917	96,560	53,997,636	1,177,680	63,545	3,949	64,812	5,710
1918	(a)	53,766,247	1,089,560				
1919	(a)	37,696,007	674,384				
1920	(a)	51,299,109	996,386				

a Figures not available.

IMPORTS.

Zinc imported and entered for consumption in the United States, 1914–1920.

Year.	Blocks or pigs.		Sheets.		Old.		Zinc dust.		Value of manufactures.	Total value.
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.		
1914	195	$21,140	277	$32,004	388	$26,512	2,004	$191,582	$4,464	$275,702
1915	63	16,864	95	14,407	729	103,294	707	137,474	622	272,661
1916	21	4,436	2	432	642	112,254	522	230,380	829	348,331
1917	18	2,279	73	16,570	259	25,974	233	48,604	250	93,677
1918	11	2,897	.....	29	24	2,056	16	3,552	331	8,865
1919	32	2,284	1	249	37	2,216	52	5,753	1,258	11,760
1920	.....	17	4	614	14	1,065	17	6,207	1,746	9,649

General imports of old brass fit only for remanufacture, 1914–1920.

[Average composition about one-third zinc and two-thirds copper.]

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1914	2,450	$487,542	1918	6,115	$1,774,002
1915	8,354	1,809,550	1919	7,938	2,157,948
1916	22,976	6,578,809	1920	22,355	5,174,885
1917	27,580	9,931,721			

In July sales of German zinc on the New York Metal Exchange were reported, although the records of the Bureau of Foreign and Domestic Commerce do not show that any great quantities of foreign zinc slabs entered the country. In August there were offerings of American zinc for reshipment from England. This zinc would enter free of duty, but fluctuations in sterling exchange rates prevented any business. The Bureau of Foreign and Domestic Commerce records such imports in a general class of "American goods returned," and hence they have not been specifically shown in the Monthly Summary. Research by the bureau has shown, however, that considerable quantities of American zinc were returned in the last four months of the year, as given in the table below.

American zinc returned, September–December, 1920.

Month.	Quantity (short tons).	Value.
September	1,577	$230,697
October	3,218	441,190
November	2,087	283,845
December	1,280	149,016
	8,162	1,104,748

General imports of zinc ore into the United States, 1904–1920.

Year.	Canada.		Mexico.		Other countries.		Total.	
	Ore (short tons).	Zinc content (short tons).	Ore (short tons).	Zinc content (short tons).	Ore (short tons).	Zinc content (short tons).	Ore (short tons).	Zinc content (short tons).
1904			2,264				2,264	
1905	4,063		18,074				22,137	
1906	423		54,991				55,414	
1907	1,112		102,005				103,117	
1908	7,406		46,351				53,757	
1909	10,024		104,826				114,850	
1910	4,749	1,922	67,877	23,517			72,626	25,439
1911	2,359	947	36,757	14,986			39,116	15,933
1912	8,015	3,661	35,925	13,606			43,940	17,267
1913	8,899	3,498	17,476	6,160	5,041	3,839	31,416	13,497
1914	11,250	4,467	20,705	7,663	7	2	31,962	12,132
1915	11,992	4,710	57,699	17,804	89,161	35,155	158,852	57,669
1916	21,908	8,790	161,271	51,028	202,785	88,329	385,964	148,147
1917	16,559	5,155	145,358	45,697	49,678	21,622	211,595	72,474
1918	14,987	5,173	53,348	18,426	2,567	1,210	70,902	24,809

Country.	1919			1920		
	Ore (short tons).	Zinc content (short tons).	Value.	Ore (short tons).	Zinc content (short tons).	Value.
Canada	10,656	3,878	$115,974	4,731	1,794	$68,286
Mexico	33,443	11,225	346,040	47,453	14,975	497,459
Australia				7,805	3,852	197,192
Other countries	4,550	1,906	67,646	5,784	1,866	74,315
	48,649	17,009	529,660	65,773	22,487	837,252

The sources of the large quantities of zinc ores imported from "Other countries" in 1915–1917, inclusive, are given in the chapter on zinc in Mineral Resources, 1918, page 1066.

EXPORTS.

DOMESTIC EXPORTS.

Domestic zinc ore and domestic manufactures of zinc exported from the United States, 1914–1920.

Year.	Zinc ore.		Pigs or slabs.		Plates and sheets.		Zinc dross.		All other manufactures.[a]	Total value.
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Value.	
1914	[b] 11,110	$388,464	[c] 64,802	[c] $8,540,668	(d)	(d)	2,536	$240,944	$210,908	$9,380,984
1915	[b] 832	35,276	[c] 118,603	[c] 29,537,680	(d)	(d)	4,167	506,956	1,951,949	32,031,861
1916	78	3,992	150,623	46,770,901	12,512	$4,540,146	48	10,801	574,229	51,900,069
1917	1,320	63,043	137,282	32,605,767	16,514	5,730,792	13,302	2,126,909	570,352	41,096,863
1918	62	2,480	66,369	12,469,622	13,875	4,566,756	15,816	2,238,913	722,671	20,000,442
1919	.....	.....	109,746	17,524,153	19,762	5,212,002	5,123	739,295	538,133	24,013,583
1920	.....	.....	74,046	12,495,144	11,852	2,832,993	2,445	316,637	1,057,676	16,702,450

[a] Not including brass.
[b] The exports consisted wholly of high-grade willemite ore from New Jersey.
[c] Includes plates and sheets.
[d] Included under pigs or slabs.

Domestic brass and brass manufactures exported from the United States, 1914–1920.

[Zinc content approximately 30 per cent by weight.]

Year.	Bars, plates, and sheets.		Scrap and old.		Articles made from (value).	Total value.
	Quantity (short tons).	Value.	Quantity (short tons).	Value.		
1914	3,558	$909,153	10,320	$2,100,870	$3,756,888	$6,766,911
1915	33,136	12,435,782	5,628	1,259,637	41,146,025	54,841,444
1916	122,266	72,683,626	3,478	1,305,050	241,668,081	315,656,757
1917	164,173	101,521,426	4,149	1,758,384	136,611,299	239,891,109
1918	15,495	9,522,934	2,455	799,318	19,483,146	29,805,398
1919	3,885	2,310,561	661	176,028	11,426,289	13,912,878
1920	2,905	1,671,608	1,030	254,189	13,202,854	15,128,651

FOREIGN EXPORTS.

Foreign zinc exported from the United States in 1914–1920.

Year.	Exported from warehouse.			Exported in manufactures with benefit of drawback, slabs and sheets excluded (short tons).
	Blocks, pigs, and old.		All other manufactures (value).	
	Quantity (short tons).	Value.		
1914	5,580	$218,145	$18,544	4,128
1915	12,775	2,355,557	119,104	32
1916	43,230	8,080,442	1,072	.....
1917	64,680	12,429,356	50	1,588
1918	20,069	3,565,127	.....	6,337
1919	12,256	1,943,507	13,071	4,533
1920	28,132	4,331,636	.....	237

CONSUMPTION.

APPARENT CONSUMPTION OF PRIMARY ZINC.

Primary zinc consumed in the United States, 1914–1920, in short tons.

	1914	1915	1916	1917	1918	1919	1920
Supply:							
Stock Jan. 1—							
In bonded warehouses	.....	111	32	90	32	.....	.....
At smelters	40,659	19,984	14,221	17,508	53,689	41,241	36,793
Production	353,049	489,519	668,343	669,573	517,927	465,743	463,377
Imports, foreign	880	904	684	257	35	70	15
Imports, domestic, returned	.....	.....	.....	.....	.....	.....	8,162
Total available	394,588	510,518	683,280	687,428	571,683	507,054	508,347
Withdrawn:							
Exports, foreign, from warehouse	5,580	12,775	43,230	64,680	20,069	12,256	28,132
Exports, foreign, under drawback	4,128	32	.....	1,588	6,337	4,533	237
Exports, domestic	64,802	118,603	163,135	153,796	80,244	129,508	85,898
Stock Dec. 31—							
In bonded warehouses	111	32	90	32	.....	.....	.....
At smelters	19,984	14,221	17,508	53,689	41,241	36,793	71,037
Total withdrawn	94,605	145,663	223,963	273,785	147,891	183,090	185,304
Apparent consumption	299,983	364,855	459,317	413,643	423,792	323,964	323,043

CONSUMPTION OF ZINC IN GALVANIZING.

Statistics of the output of galvanized sheets, galvanized formed products made from iron or steel sheets, and galvanized wrought iron and steel pipe are gathered by the American Iron and Steel Institute from all the manufacturers of these products and are published yearly. Other classes of galvanized products, such as wire, barbed wire, cast and forged products, and nails, spikes, and bolts are not taken into statistical account by the Institute. As described on pages 1071–1072 of Mineral Resources for 1918, Part I, a fairly close estimate can be formed of the quantity of zinc used in coating these reported products and, though representing only a part of the total zinc consumed in galvanizing, a comparison of the yearly figures gives a good idea of the relative condition of the galvanizing industry. On this basis the estimated consumption of zinc in galvanizing in 1920 was considerably in excess of the quantity used in 1913 and 1914, as shown in Mineral Resources for 1915, Part I, and almost 50 per cent larger than the consumption in 1918.

Galvanized iron and steel sheets, formed products, and pipe produced in the United States, 1915–1920, in short tons, with an estimate of the quantity of zinc used in galvanizing them.

	1915	1916	1917	1918	1919	1920
Galvanized iron and steel sheets [a]	790,785	673,462	636,989	579,889	750,288	935,680
Galvanized formed products [a] [b]	56,096	65,151	57,451	60,555	70,247	71,947
Galvanized pipe [a]	314,657	325,935	308,342	296,444	300,335	355,397
	1,161,538	1,064,548	1,002,782	936,888	1,120,870	1,363,024
Zinc used (estimated)	139,385	127,746	120,334	112,427	134,504	163,563
Zinc used in galvanized wire [c]	.....	.....	.....	.....	25,850	.....

[a] From annual statistical reports of American Iron and Steel Institute.
[b] Articles formed or stamped from iron or steel sheets and galvanized after shaping.
[c] Census of 1919.

PRICES AND VALUE.

The price of prime western zinc began the year at 9.05 cents in the St. Louis market, rose to 9.375 cents on January 12, declined to 7.35 cents on June 18, rose to 8.15 cents on August 24, and then dropped sharply to 5.625 cents on November 30. A short rise carried the price up to 6.25 cents on December 6, but it declined again and finished the year at about 5.5 cents. The decline in the last quarter of the year was coincident with offerings of foreign zinc at New York at prices below the current St. Louis quotations, plus the freight differential.

The average quotation for prime western zinc at St. Louis in 1920 was 7.8 cents a pound, compared with 7 cents in 1919 and 8 cents in 1918.

Experience has shown that large sales of zinc for future delivery at considerable variations in price, as well as the sales of metal of better grades than prime western at much higher prices than that grade, render the average price quoted for prime western zinc an unsafe guide to the average value of all zinc sold. A canvass of the actual sales of zinc and the prices received in 1920 gives 8.1 cents a pound as the average selling price of all grades. The average selling price for all grades is the price used in calculating the value of the zinc output of the country.

Prices of zinc, by grades, 1914–1920.

[In cents per pound; average price received except as otherwise stated.]

	1914	1915	1916	1917	1918	1919	1920
Grade A (high grade of 1913–1916)	[a] 8.0	[a] 31.1	[a] 23.2	14.0	11.1	8.3	8.4
Grade B (intermediate of 1913–1916)				12.7	10.7	7.7	8.3
Grade C (select and brass special of 1913–1916)				9.4	8.0	7.2	8.2
Grade D (prime western)				9.0	7.9	7.1	8.0
All grades		12.4	13.4	10.2	9.1	7.3	8.1
Prime western, average spot quotation at St. Louis	5.1	14.2	13.6	8.9	8.0	7.0	7.8

[a] Am. Zinc Inst. Bull., vol. 3, No. 3, p. 7, 1920; averaged from monthly prices.

In London zinc started the year at £58 10s. a long ton (9.9 cents a pound). With a few brief recoveries the trend was sharply downward throughout the year. At the end of November the price was £29 7s. 6d. a long ton (4.6 cents a pound); it rose by December 8 to £32 10s. (5 cents a pound) but fell again to £22 10s. (3.5 cents a pound) on December 23 and closed the year at £26 a long ton (4.1 cents a pound). The average price for the year was £45 4s. 6d. a long ton.

Rolled zinc is quoted at so much a pound, with discounts and extras for different gages and special sizes and shapes. On January 6 the price of zinc sheets was advanced to 12 cents, and on January 15 to 12.5 cents. The basic quotation remained at 12.5 cents a pound until November 8, when it was reduced to 11.5 cents and plates to 10.5 cents, and there was no further change during the year.

Zinc dust at the beginning of 1920 was quoted at 11 to 13 cents a pound, the price depending on quality. The price rose to 12¼ to 14 cents a pound in April and remained at those figures until the last week in November, after which the price was 9¾ to 10¼ cents. The average of the year's quotations was 12.6 cents a pound. The

average price received during the year as reported by producers was 11.1 cents, and "atomized" zinc dust brought 11.3 cents a pound.

Figure 6 shows graphically for the years 1919–1920 the relations of the weekly average St. Louis quoted price of zinc, the weekly average London price of zinc, the weekly average price of 60 per cent zinc blende concentrates at Joplin, Mo., and the weekly sales of concentrates in the Joplin region as a whole. The price of zinc has been taken from market reports, and the price of zinc blende and the figures of weekly sales are those published in the Joplin daily papers. To eliminate the sharp weekly fluctuations and to obtain a curve more easily comparable with the price curves, the weekly sales have been averaged by months, the result being shown by the broken lines.

Distilled and electrolytic zinc produced in the United States, 1914–1920.

Year.	Domestic primary.		Foreign primary.		Redistilled secondary.		Total.	
	Quantity (short tons).	Value.[a]	Quantity (short tons).	Value.[a]	Quantity (short tons).	Value.[a]	Quantity (short tons).	Value.[a]
1914	343,418	$35,029,000	9,631	$982,000	20,545	$2,096,000	373,594	$38,107,000
1915	458,135	113,617,000	31,384	7,783,000	29,764	7,381,000	519,283	128,781,000
1916	564,338	151,243,000	104,005	27,873,000	28,776	7,712,000	697,119	186,828,000
1917	584,597	119,258,000	84,976	17,335,000	16,835	3,434,000	686,408	140,027,000
1918	492,405	89,618,000	25,522	4,645,000	9,918	1,805,000	527,845	96,068,000
1919	452,272	66,032,000	13,471	1,967,000	19,748	2,883,000	485,491	70,882,000
1920	450,045	72,907,000	13,332	2,160,000	21,371	3,462,000	484,748	78,529,000

[a] Value based on average St. Louis quotations prior to 1915; for 1915 and later years, on the average selling price for all grades.

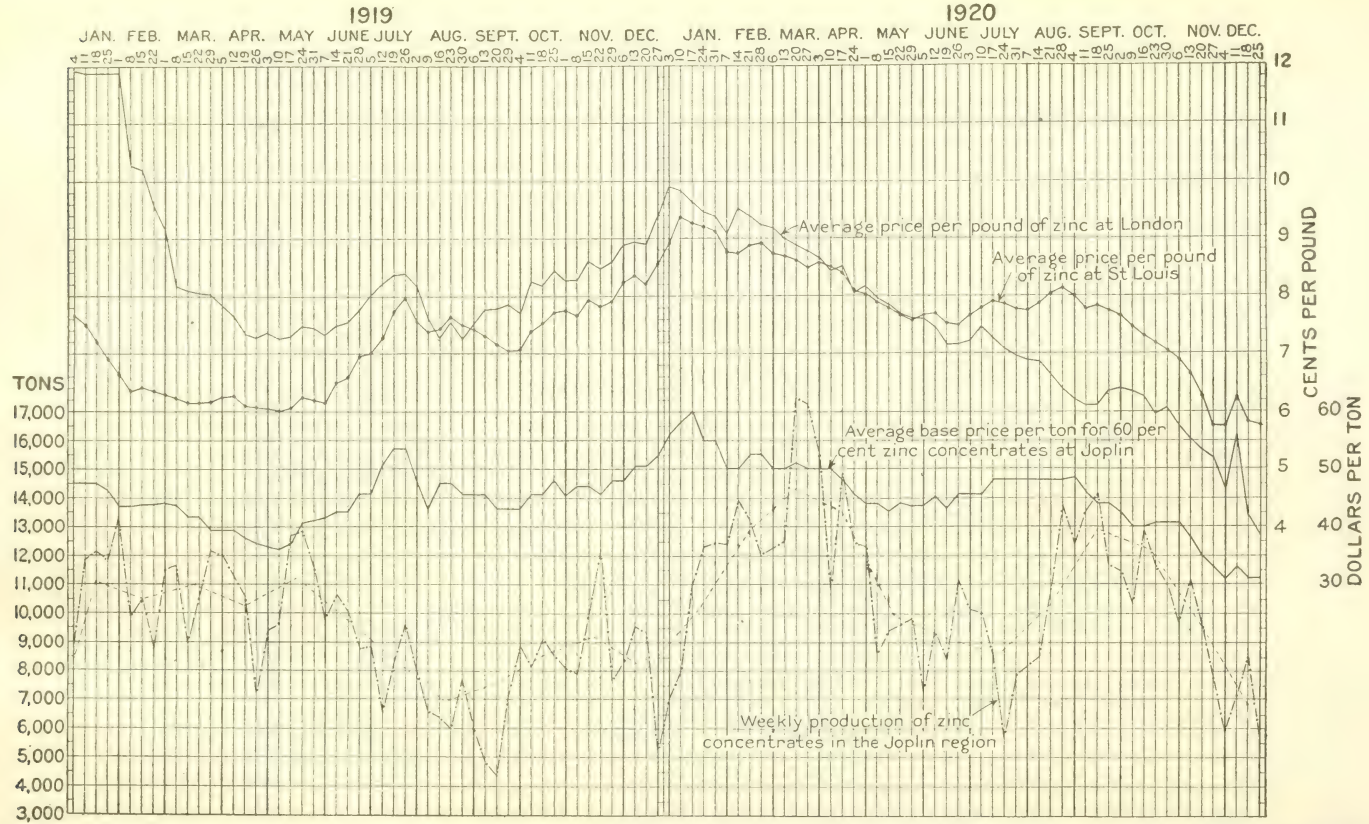

FIGURE 6.—Average weekly price of zinc at St. Louis and London and of 60 per cent zinc concentrates at Joplin, and weekly production (sales) of zinc concentrates in the Joplin region, 1919-20. The broken line shows the weekly production (sales) in the Joplin region, averaged by months

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO.

(MINES REPORT.)

By C. N. Gerry.[1]

PRODUCTION.

GENERAL STATEMENT.

The value of the mine production of gold, silver, copper, lead, and zinc in Idaho in 1920 increased nearly 70 per cent over the value for 1919. The output of all metals except gold and copper was greater than that of 1919, as many of the mines which were idle during that year on account of a labor strike were again active in 1920. Production, however, did not reach the average of the last 10 years. The average prices of silver and copper were lower than those of 1919, and the demand for the metals was poor. Dividends for 1920 amounted to $5,220,174, including an estimate for the Hercules and Tamarack & Custer mines.

Since 1863 the State has been an important producer of the five metals, and of the total value to the end of 1920 lead represents $330,568,180, silver $176,186,930, gold $132,812,613, copper $22,223,200, and zinc $41,838,931.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	210	1,457,395	$713,238	5,579,056	3,122,763	182,341,898	15,994,229	$18,374,315
1920	163	1,958,401	485,590	7,326,794	2,538,396	249,609,976	27,932,326	31,170,176
Increase or decrease, 1920	−47	+501,006	−227,648	+1,747,738	−584,367	+67,268,078	+11,938,097	+12,795,861
Total, 1863–1920	.....	.....	132,812,613	246,784,145	128,559,976	6,497,996,119	430,306,907	703,629,854

[1] The work of tabulating the figures and compiling the tables used in this report was done by B. N. Patchell, of the United States Geological Survey.

The following table shows a distinct decrease in gold from placers and siliceous ore; silver, lead, and zinc increased from the main sources:

Ore and metals produced in Idaho in 1920.

Source of production.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Placers	49	.....	5,505.76	1,119	.....	.....	.....
Dry or siliceous ore	31	39,811	13,806.37	91,752	50,437	17,540	.....
Copper ore	10	19,259	1,418.69	52,029	1,738,541	420	.....
Lead ore	71	1,480,177	2,497.21	6,091,408	657,627	210,039,183	.....
Zinc ore	3	2,419	.....	2,870	.....	55,609	1,308,319
Copper-lead ore	3	5,015	95.83	225,181	69,791	225,308	.....
Lead-zinc ore	3	411,720	166.56	862,435	22,000	39,271,916	26,624,007
	.....	1,958,401	23,490.42	7,326,794	2,538,396	249,609,976	27,932,326

ORE.

The quantity of ore sold or treated in Idaho increased more than 34 per cent in 1920 over 1919. Most of the output was lead ore (nearly 76 per cent) and lead-zinc ore (more than 21 per cent); copper ore represented nearly 1 per cent; siliceous ore more than 2 per cent; and zinc ore and copper-lead ore less than 1 per cent. The siliceous ore sold or treated averaged per ton as follows: Gold, $7.17; silver, 2.3 ounces; copper and lead, trace. The copper ore averaged $1.52 in gold and 2.7 ounces of silver per ton and contained 4.51 per cent of copper. Most of the siliceous ore was treated by amalgamation or cyanidation, and most of the copper ore was smelted. The averages of the crude shipping product are given later. Lead ore as mined averaged 3 cents in gold and 4.12 ounces of silver per ton and contained 0.02 per cent of copper and 7.1 per cent of lead. The total zinc ore mined or treated averaged 1.19 ounces of silver per ton and contained 1.15 per cent of lead and 27.04 per cent of recoverable zinc. Copper-lead ore averaged 39 cents in gold and 44.9 ounces of silver per ton and contained 0.7 per cent of copper and 2.25 per cent of lead. Lead-zinc ore averaged 2.09 ounces of silver per ton and contained a trace of copper, 4.77 per cent of lead, and 3.23 per cent of recoverable zinc. Most of the lead ore and lead-zinc ore was milled; the results are stated in the text following the table on concentrates (p. 242).

Ore sold or treated in Idaho in 1920, by counties, in short tons.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Adams		71					71
Blaine	11		21,125				21,136
Boise	35,510		15				35,525
Bonner	32		7				39
Boundary			28,070				28,070
Butte			1				1
Camas			63				63
Custer	12	15,807	7,371		5,015		28,205
Elmore	77						77
Fremont		90					90
Gem	21	40					61
Idaho	34						34
Lemhi	2,892	3,251	15,192				21,335
Owyhee	96		5				101
Shoshone	21		1,408,328	2,419		411,720	1,822,488
Washington	1,105						1,105
	[a] 39,811	19,259	1,480,177	2,419	5,015	411,720	1,958,401
Average value per ton in gold and silver	$9.68	$4.47	$4.52	$1.29	$49.34	$2.29	$4.27

[a] Includes 38,534 tons of gold ore, 5 tons of gold and silver ore, and 1,272 tons of silver ore.

About 2 per cent of the ore was treated in gold and silver mills in 1920. Bullion from this ore treated by amalgamation and cyanidation was valued at $226,568, or $5.87 a ton, a decided decrease in both the quantity of the bullion and the value per ton. Mines that produce gold, especially in central Idaho, have been particularly handicapped by the cost of mining and transportation. Nearly all the gold in bullion was won by amalgamation, and 737 pounds of mercury and 1,600 pounds of sodium cyanide were used at these mills in 1920. The average consumption of quicksilver was 0.019 pound per ton of ore amalgamated and 0.053 pound per ounce of gold and silver bullion saved. The consumption of cyanide was 4.79 pounds per ton of ore treated and 2.7 pounds per ounce of gold and silver bullion recovered.

Gold and silver produced in mills in Idaho in 1920 by counties.

County.	Ore.	Bullion recovered from ore by—				Total value.
		Amalgamation.		Cyanidation.		
		Gold.	Silver.	Gold.	Silver.	
	Short tons.	*Fine oz.*	*Fine oz.*	*Fine oz.*	*Fine oz.*	
Blaine	4	4.09	1			$85
Boise	[a] 35,509	9,662.50	2,092	204.45	363	206,644
Custer	10			5.69	18	138
Elmore	77	38.49	46			846
Gem	1			.75	1	16
Idaho	34	31.79	14			672
Lemhi	[b] 2,892	801.30	131			16,707
Owyhee	43	17.98	998			1,460
	38,570	10,556.15	3,282	210.89	382	226,568

[a] Also yielded 1,497 tons of concentrates. [b] Also yielded 24 tons of concentrates.

Nearly 84 per cent of the ore was concentrated. Concentrates from this ore, from 173,943 tons of old tailings treated and from ore treated in gold and silver mills aggregating 276,955 tons, were valued at $88.55 a ton in 1920, against $69.99 in 1919. The concentrates were largely from the Coeur d'Alene region, and the ratio was 6.6 tons of ore and tailings to 1 ton of concentrate. Nearly 88 per cent of the total was lead concentrate, and more than 11 per cent was zinc concentrate. Operators in Shoshone County shipped an average of 22,351 tons of concentrates of various kinds per month, against 15,467 tons in 1919. This with the crude ore shipped, which was 5,379 tons a month, gives the Coeur d'Alene region an average monthly output of 27,730 tons of concentrates and crude ore, against 19,523 tons in 1919.

Mine production of metals from Idaho concentrates in 1920.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Blaine	15,936	2,986	505.49	188,012	29,463	1,363,191	.....	$329,858
Boise	.....	1,497	2,912.33	5,871	.....	.....	.....	66,602
Boundary	27,670	2,767	21.75	60,414	.....	3,090,740	.....	313,560
Custer	5,480	780	5.84	223,729	68,568	318,942	.....	282,119
Lemhi	6,492	705	74.89	7,907	106,659	297,522	.....	53,594
Owyhee	50	5	70.00	14,269	.....	.....	.....	17,000
Shoshone	1,588,274	268,215	1,053.22	4,957,522	360,785	197,475,076	26,802,018	23,460,824
	1,643,902	276,955	4,643.52	5,457,724	565,475	202,545,471	26,802,018	24,523,557

By kinds of concentrates.

Dry or siliceous	.....	1,502	2,982.33	20,140	.....	.....	.....	$83,602
Copper	.....	289	21.52	218	105,159	.....	.....	20,032
Lead	.....	243,562	1,633.83	5,159,756	391,748	200,958,406	.....	21,806,663
Zinc	.....	30,942	.....	56,535	.....	1,363,824	26,802,018	2,341,692
Copper-lead	.....	660	5.84	221,075	68,568	223,241	.....	271,568

The concentrates had the following average contents: Siliceous concentrates contained $41.04 in gold and 13.41 ounces of silver, and had a value of $55.66 a ton for all metals. Copper concentrates contained $1.54 in gold and 0.75 ounce of silver per ton and 18.19 per cent of copper, a total value of $69.31 a ton. Lead concentrates averaged 14 cents in gold and 21.18 ounces of silver per ton, 0.08 per cent of copper, and 41.25 per cent of lead, or a total value of $89.53 a ton. Zinc concentrates averaged 1.83 ounces of silver per ton, 2.2 per cent of lead, and 43.31 per cent of recoverable zinc, or a total value of $75.68 a ton.

Of the total ore more than 5 per cent was shipped crude to smelters, and most of it with the concentrates was treated at East Helena, Mont., Bradley, Idaho, and Northport, Wash. The total value of the first-class ore was $6,305,017, or $61.82 a ton. More than 81 per cent of the crude ore shipped was lead ore and more than 16 per cent was copper ore. The combined value of the concentrates and crude ore shipped was $30,828,574. Most of the ore smelted was sulphide. A close separation of oxidized and sulphide por-

tions, with average content per ton, is as follows: Copper ore shipped consisted of 8,114 tons of oxidized and carbonate ore, averaging $1.78 in gold and 1.87 ounces of silver per ton and 4.85 per cent of copper, or a total value of $21.67 a ton; and of 8,233 tons of sulphide ore, averaging $1.75 in gold and 4.45 ounces of silver per ton and 5.14 per cent of copper, or a total value of $25.52 a ton. The first-class oxidized lead ore (18,020 tons) averaged 82 cents in gold and 10.59 ounces of silver per ton, 0.21 per cent of copper, and 18.92 per cent of lead, or a total value of $43.42 a ton; and the sulphide lead ore shipped (64,994 tons) averaged 11 cents in gold and 23.8 ounces of silver per ton, 0.16 per cent of copper, and 30.92 per cent of lead, or a total value of $76.12 a ton. All the crude zinc ore shipped was sulphide ore. One shipment of copper-lead ore was sulphide.

Mine production of metals from Idaho crude ore shipped to smelters in 1920.

By counties.

County.	Quantity.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Shorttons.	*Fine oz.*	*Fine oz.*	*Pounds.*	*Pounds.*	*Pounds.*	
Adams	71	.....	156	21,303	.....	.....	$4,090
Blaine	922	125.78	97,232	1,303	786,402	.....	171,735
Boise	16	1.46	436	26	1,650	.....	642
Bonner	39	.76	2,211	317	2,307	.....	2,669
Boundary	400	3.00	6,800	.....	338,800	.....	34,578
Butte	1	.....	2	.....	144	.....	14
Camas	63	22.16	655	1,679	6,319	.....	1,987
Custer	22,715	1,536.60	125,259	1,506,663	1,613,146	.....	574,572
Fremont	90	.....	92	24,404	.....	.....	4,590
Gem	60	14.20	6,363	4,288	879	.....	8,089
Lemhi	11,951	639.88	133,965	153,480	5,578,853	.....	633,799
Owyhee	8	19.65	274	.....	780	.....	767
Shoshone	64,545	210.60	1,428,241	210,334	38,735,225	1,130,308	4,790,211
Washington	1,105	.....	62,601	49,124	.....	.....	77,274
	101,986	2,574.09	1,864,287	1,972,921	47,064,505	1,130,308	6,305,017

By kinds of ore.

Dry or siliceous	1,191	16.16	67,807	49,937	1,057	.....	$83,517
Copper	16,347	1,397.17	51,811	1,633,382	420	.....	385,932
Lead	83,014	1,070.76	1,737,693	288,379	47,005,352	.....	5,729,710
Zinc	1,419	.....	2,870	.....	55,609	1,130,308	99,132
Copper-lead	15	90.00	4,106	1,223	2,067	.....	6,726

The crude ore shipped had the following averages: Siliceous ore averaged 28 cents in gold and 56.93 ounces of silver per ton, 2.1 per cent of copper, and 0.04 per cent of lead, or a total value of $70.12 a ton. Copper ore averaged $1.77 in gold and 3.17 ounces of silver per ton and 5 per cent of copper, or a total value of $23.61 a ton. Lead ore averaged 27 cents in gold and 20.93 ounces of silver per ton, 0.17 per cent of copper, and 28.31 per cent of lead, or a total value of $69.02 a ton. The crude zinc ore averaged 2.02 ounces of silver per ton, 1.96 per cent of lead, and 39.83 per cent of recoverable zinc, or a total value of $69.86 a ton.

GOLD.

The mine production of gold in Idaho in 1920 was valued at $485,590, a decrease of 32 per cent. The average yearly output in the

last 10 years is more than $1,000,000, but the output has decreased steadily since 1911. The mines of Boise County had the largest output of gold; Shoshone County was second, on account of the operations of the dredge at Murray. The lode mines produced gold valued at $371,776, and the placers produced gold valued at $113,814, of which $101,679 was won by dredges. Of the total gold, more than 23 per cent came from placers, more than 58 per cent from siliceous ore, 6 per cent from copper ore, and about 11 per cent from lead ore. The production of gold from amalgamation and cyanidation mills decreased to 10,767.04 ounces, or 46 per cent of the total. Concentrates of all kinds contained nearly 20 per cent of the total gold, and crude ore shipped to smelters contained nearly 11 per cent of the total. Since 1897 a total of $4,287,798 has been recovered by dredges.

In 1920 only three mines had a gold output of more than $25,000 each—the Gold Hill & Iowa Mines Co., at Quartzburg; the Yukon Gold Co., at Murray; and the Empire Copper Co., at Mackay.

Mine production of gold in Idaho in 1920, by counties, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Ada	3.39						3.39
Benewah	24.33						24.33
Blaine		7.11		628.25			635.36
Boise	77.11	[a]12,779.27		1.45			12,857.83
Bonner		.29		.48			.77
Bonneville	16.74						16.74
Boundary				24.77			24.77
Camas				22.16			22.16
Clearwater	357.25						357.25
Custer	56.89	5.70	1,369.01	77.60	95.83		1,605.03
Elmore	4.94	38.50					43.44
Gem		4.94	10.01				14.95
Idaho	174.59	31.78					206.37
Latah	14.37						14.37
Lemhi	68.40	842.15	39.67	634.25			1,584.47
Owyhee		96.63		11.01			107.64
Shoshone	4,633.11			1,097.24		166.56	5,896.91
Twin Falls	2.61						2.61
Valley	72.03						72.03
	5,505.76	[a]13,806.37	1,418.69	2,497.21	95.83	166.56	23,490.42

[a] Includes 13,708.33 ounces from gold ore, 9.55 ounces from gold and silver ore, and 88.49 ounces from silver ore.

SILVER.

The mine production of silver in Idaho in 1920 increased more than 31 per cent, and the improvement was especially noticeable in Shoshone and Custer counties. A separation of the silver according to source shows that the largest part of the total silver yield, or more than 83 per cent, was from lead ore, nearly 12 per cent from lead-zinc ore, more than 3 per cent from copper-lead ore, and 2 per cent from other sources. Shoshone County produced more than 87 per cent of the silver. Concentrates contained more than 74 per cent of the silver, shipping ore more than 25 per cent, and gold and silver bullion and placer bullion less than 1 per cent.

Ten mines in Idaho produced more than 84 per cent of the total silver in 1920. They were the Hercules, Bunker Hill, Hecla, Morning, Tamarack & Custer, Gold Hunter, Caledonia, Callahan, Ramshorn, and Independence mines. Each of these produced more than

200,000 ounces of silver, and five of them produced more than 500,000 ounces.

Mine production of silver in Idaho in 1920, by counties, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Adams			156					156
Benewah	2							2
Blaine		353		284,892				285,245
Boise	21	8,696		66				8,783
Bonner		2,108		103				2,211
Bonneville	1							1
Boundary				67,214				67,214
Butte				2				2
Camas				655				655
Clearwater	89							89
Custer	23	149	46,460	77,216		225,181		349,029
Elmore	2	46						48
Fremont			92					92
Gem		1,564	4,800					6,364
Idaho	25	14						39
Latah	1							1
Lemhi	7	272	521	141,210				142,010
Owyhee		15,498		43				15,541
Shoshone	900	451		5,520,007	2,870		862,435	6,386,663
Twin Falls	1							1
Valley	47							47
Washington		62,601						62,601
	1,119	[a]91,752	52,029	6,091,408	2,870	225,181	862,435	7,326,794

[a] Includes 8,669 ounces from gold ore, 135 ounces from gold and silver ore, and 82,948 ounces from silver ore.

COPPER.

The mine production of copper in Idaho in 1920 decreased nearly 19 per cent. Copper from Shoshone County decreased considerably, as the National and Richmond mines were idle. The Empire property, near Mackay, Custer County, is still the largest producer of copper in the State, and there was some activity at the Harmony and other mines in Lemhi County. More than 68 per cent of the total output was from copper ore, and about 26 per cent was from lead ore. Crude shipping ore of all kinds contained nearly 78 per cent of the copper and concentrates more than 22 per cent.

Mine production of copper in Idaho in 1920, by counties, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Adams		21,303				21,303
Blaine	75		30,691			30,766
Boise	26					26
Bonner	317					317
Camas			1,679			1,679
Custer	44	1,489,485	15,911	69,791		1,575,231
Fremont		24,404				24,404
Gem		4,288				4,288
Lemhi	500	199,061	60,578			260,139
Shoshone	351		548,768		22,000	571,119
Washington	49,124					49,124
	[a] 50,437	1,738,541	657,627	69,791	22,000	2,538,396

[a] Includes 500 pounds from gold ore and 49,937 pounds from silver ore.

LEAD.

The mine production of lead in Idaho in 1920 increased nearly 37 per cent, which corresponds closely with the decrease in 1919 resulting from the labor strike in Shoshone County. The value of the output of lead in 1920 was nearly double the combined value of the output of the other four metals. Shoshone County supplied more than 94 per cent of the total output, but a good production was made by Lemhi, Boundary, Blaine, and Custer counties. Lead ore supplied more than 84 per cent of the total and lead-zinc ore nearly 16 per cent. Concentrates of all kinds produced more than 81 per cent of the total, and crude ore shipped was the source of nearly 19 per cent. The average price of lead for 1920 was 8 cents a pound, 2.7 cents more than in 1919.

Fifteen mines produced more than 1,000,000 pounds of lead each in 1920, and seven of them—the Bunker Hill, Hercules, Morning, Hecla, Tamarack & Custer, Callahan, and Gold Hunter—produced more than 10,000,000 pounds each.

Mine production of lead in Idaho in 1920, by counties, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Blaine	86	.....	2,149,507	.....	.....	.....	2,149,593
Boise	42	.....	1,608	.....	.....	.....	1,650
Bonner	.....	.....	2,307	.....	.....	.....	2,307
Boundary	.....	.....	3,429,540	.....	.....	.....	3,429,540
Butte	.....	.....	144	.....	.....	.....	144
Camas	.....	.....	6,319	.....	.....	.....	6,319
Custer	50	420	1,706,310	.....	225,308	.....	1,932,088
Gem	879	.....	.....	.....	.....	.....	879
Lemhi	16,483	.....	5,859,892	.....	.....	.....	5,876,375
Owyhee	.....	.....	780	.....	.....	.....	780
Shoshone	.....	.....	196,882,776	55,609	.....	39,271,916	236,210,301
	[a]17,540	420	210,039,183	55,609	225,308	39,271,916	249,609,976

[a] Includes 16,483 pounds from gold ore and 1,057 pounds from silver ore.

ZINC.

The mine production of recoverable zinc in Idaho, wholly from the Coeur d'Alene region, increased about 75 per cent in 1920. The Callahan property retained first place among the zinc producers of the State, and the Morning mine was second. Lead-zinc ore supplied more than 95 per cent of the zinc, and zinc ore nearly 5 per cent. Both the zinc concentrates and the crude zinc ore shipped were sulphide products. Nearly all the zinc material was smelted in eastern plants, though the freight rate was high. The average price of metallic zinc was 8.1 cents a pound, 0.8 cent more than the price in 1919.

Four mines—the Callahan, Morning, Frisco, and Success—produced most of the zinc.

Shipments of zinc ore and concentrates amounted to 32,361 tons, of which the gross content was 32,864,384 pounds of zinc, or an average of 50.78 per cent.

REDUCTION PLANTS.

In Idaho 36 milling plants of all kinds were in operation in 1920, against 40 in 1919. Of these mills 27 were concentration plants, 14 of which used flotation machines with other concentrating devices, 2 used flotation alone, and 11 used crushers, jigs, and tables without flotation cells; 6 used amalgamation alone; 2 used amalgamation and concentration; and 1 used amalgamation, concentration, and cyanidation. Several plants were under construction or being remodeled in 1920. A complete list of mills in Idaho giving the process and equipment of each has been prepared, and a copy may be obtained from the Bureau of Mines, Washington, D. C.

MINING INDUSTRY.

Mining conditions in Idaho improved in 1920, as compared with 1919, when production was small on account of a labor strike. The total value of the metal output was 14 per cent less than that of 1918, when most of the large mines were active. Metal prices were higher in the first half of 1920 and the labor situation was better, but costs were excessive, particularly during the last half of the year, when prices dropped and the metal market was poor. The mines of the Coeur d'Alene region reported a large increase in net profits, but their expenses for mining, freight, and treatment were unusually high. The Bunker Hill smelter, which was active in 1920, has been a great benefit to the mines of Shoshone County in reducing the cost of freight and treatment.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1920, by counties.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total value.		
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.		Quantity (fine ounces).	Value.
Ada	3.39	$70			$70		
Adams						156	$170
Benewah	24.33	503			503	2	2
Blaine			635.36	$13,134	13,134	285,245	310,917
Boise	77.11	1,594	12,780.72	264,201	265,795	8,783	9,573
Bonner			.77	16	16	2,211	2,410
Bonneville	16.74	346			346	1	1
Boundary			24.77	512	512	67,214	73,263
Butte						2	2
Camas			22.16	458	458	655	714
Clearwater	357.25	7,385			7,385	89	97
Custer	56.89	1,176	1,548.14	32,003	33,179	349,029	380,442
Elmore	4.94	102	38.50	796	898	48	52
Fremont						92	100
Gem			14.95	309	309	6,364	6,937
Idaho	174.59	3,609	31.78	657	4,266	39	43
Latah	14.37	297			297	1	1
Lemhi	68.40	1,414	1,516.07	31,340	32,754	142,010	154,791
Owyhee			107.64	2,225	2,225	15,541	16,940
Shoshone	4,633.11	95,775	1,263.80	26,125	121,900	6,386,663	6,961,463
Twin Falls	2.61	54			54	1	1
Valley	72.03	1,489			1,489	47	51
Washington						62,601	68,235
	5,505.76	113,814	17,984.66	371,776	485,590	7,326,794	7,986,205

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1920, by counties.—Continued.

County.	Copper.		Lead.		Recoverable zinc.		Total value.
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	
Ada							$70
Adams	21,303	$3,920					4,090
Benewah							505
Blaine	30,766	5,661	2,149,593	$171,967			501,679
Boise	26	5	1,650	132			275,505
Bonner	317	58	2,307	185			2,669
Bonneville							347
Boundary			3,429,540	274,363			348,138
Butte			144	12			14
Camas	1,679	309	6,319	506			1,987
Clearwater							7,482
Custer	1,575,231	289,842	1,932,088	154,567			858,030
Elmore							950
Fremont	24,404	4,490					4,590
Gem	4,288	789	879	70			8,105
Idaho							4,309
Latah							298
Lemhi	260,139	47,866	5,876,375	470,110			705,521
Owyhee			780	62			19,227
Shoshone	571,119	105,086	236,210,301	18,896,824	27,932,326	$2,262,518	28,347,791
Twin Falls							55
Valley							1,540
Washington	49,124	9,039					77,274
	2,538,396	467,065	249,609,976	19,968,798	27,932,326	2,262,518	31,170,176

Though the output of silver, lead, and zinc exceeded that of 1919, the output was less than that of 1918 and was far less than the average of the last 10 years.

Producing placer mines and production of gold and silver in Idaho in 1919 and 1920, by counties.

County.	1919						1920					
	Mines.			Gold.	Silver.	Total value.	Mines.			Gold.	Silver.	Total value.
	Hydraulic.	Dredge.	Drift.				Hydraulic.	Dredge.	Drift.			
					Fine ounces.						*Fine ounces.*	
Ada	1	....	....	$242	3	$245	1	....	....	$70	.....	$70
Benewah	1	....	....	2,410	12	2,423	2	....	....	503	2	505
Boise	12	....	....	5,607	73	5,689	5	....	....	1,594	21	1,616
Bonneville	2	....	....	2,333	3	2,336	1	....	....	346	1	347
Clearwater	5	1	....	11,725	138	11,880	4	1	....	7,385	89	7,482
Custer	1	....	....	93	3	96	5	....	....	1,176	23	1,201
Elmore	4	....	....	881	8	890	1	....	....	102	2	104
Idaho	24	....	....	4,921	42	4,968	15	....	1	3,609	25	3,637
Latah	2	....	....	452	1	453	2	....	....	297	1	298
Lemhi	7	1	....	3,407	22	3,432	4	....	....	1,414	7	1,422
Owyhee	1	....	....	121	4	126	....	....	....	.....	.....	.....
Shoshone	4	1	....	156,443	1,535	158,162	2	1	....	95,775	900	96,756
Twin Falls	2	....	....	51	.....	51	1	....	....	54	1	55
Valley	3	....	....	2,066	58	2,131	3	....	....	1,489	47	1,540
	69	3	....	190,752	1,902	192,882	46	2	1	113,814	1,119	115,033

The output of placer gold was greatest where dredges were operated, but much ground formerly worked by dredges in Lemhi, Boise, Custer, and Clearwater counties has been exhausted.

Ores sold or treated, deep mines producing, and average value of ores in Idaho in 1919 and 1920, by counties.

County.	Ore sold or treated in 1920.		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	Quantity.	Increase or decrease.	1919	1920	1919	1920	1919	1920
	Short tons.	*Short tons.*						
Adams	71	— 7	1	1	$69.68	$57.60	$5.31	$2.39
Blaine	21,136	— 2,897	16	16	18.19	23.74	13.29	15.33
Boise	35,525	— 5,305	12	8	10.53	7.71	10.52	7.71
Bonner	39	— 137	2	3	24.68	68.44	7.66	62.21
Boundary	28,070	— 16,479	1	1	9.37	12.40	2.57	2.63
Butte	1	— 275	1	1	34.06	14.00	15.41	2.00
Camas	63	+ 50	4	1	96.23	31.54	75.85	18.60
Cassia	.....	— 360	1	.....	13.54	.....	7.92	.....
Clearwater	.....	— 2	1	.....	11.00	.....	11.00	.....
Custer	28,205	+ 12,664	19	17	27.74	30.38	8.36	14.62
Elmore	77	— 242	4	2	6.45	10.99	6.45	10.99
Fremont	90	+ 53	1	1	52.78	51.00	.92	1.11
Gem	61	— 426	4	3	45.05	132.87	44.50	118.79
Idaho	34	— 1,050	9	2	8.20	19.76	8.05	19.76
Latah	.....	— 38	1	.....	62.13	.....	1.74	.....
Lemhi	21,335	+ 3,765	20	15	29.70	33.00	10.92	8.72
Owyhee	101	— 2,602	6	6	13.10	190.36	13.10	189.75
Shoshone	1,822,488	+514,425	33	36	12.04	15.50	4.14	3.83
Washington	1,105	— 131	2	1	83.78	69.93	74.24	61.75
	1,958,401	+501,006	138	114	12.48	15.86	4.64	4.27

REVIEW BY COUNTIES.

In the following review by counties and mining districts mention of small producers has been omitted.

ADAMS COUNTY.

Several lots of oxidized copper ore were shipped from the River Queen mine, in the Seven Devils district.

BLAINE COUNTY.

Mine production in Blaine County, Idaho, in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	16	24,033	$13,220	273,279	18,643	2,157,300	.....	$437,098
1920	16	21,136	13,134	285,245	30,766	2,149,593	.....	501,679
Increase or decrease, 1920	0	−2,897	−86	+11,966	+12,123	−7,707	.....	+64,581
Total, 1880–1920	.....	.....	2,505,326	16,361,115	281,995	188,169,181	7,997,090	26,391,140

The value of the output of Blaine County increased nearly 15 per cent in 1920, though the quantity of ore treated was less. The ore and old tailings treated had an average value of $23.74 a ton and a value in gold and silver of $15.33 a ton. Most of the ore and tail-

ing was milled and produced concentrates which had an average value of $119.47 a ton. Crude ore shipped had an average value of $186.26 a ton. From 1880 to 1920 Blaine County has produced $2,505,326 in gold, $14,923,595 in silver, $52,805 in copper, $8,260,865 in lead, and $648,549 in zinc.

Mineral Hill district (*Hailey*).—Eleven deep mines in the Mineral Hill district produced 4,593 tons of ore and tailings, which contained $570 in gold, 33,972 ounces of silver, 2,884 pounds of copper, and 358,570 pounds of lead, valued in all at $66,816, or $14.55 a ton. The largest production came from the treatment of old tailings from the Minnie Moore property. The best shipping ore came from the Lark mine.

Warm Springs district (*Ketchum*).—Four deep mines in the Warm Springs district produced 16,541 tons of ore, containing $12,518 in gold, 251,272 ounces of silver, 27,882 pounds of copper, and 1,791,023 pounds of lead, valued in all at $434,816, or $26.29 a ton. Most of the output was milling ore from the Independence and Golden Glow properties. The Independence mine was operated a full year and the mill for six months. Connection was made with the North Star mine by a 530-foot inclined raise, and the North Star mill was remodeled to treat lead ore from the Independence mine. The ore mined was 13,074 tons,[2] and operations resulted in a loss of $40,059, due to the deduction of costs for driving of the Plummer tunnel. Ore reserves at the end of the year were 40,000 tons, equal to 2,700 tons of first-class lead ore and 5,185 tons of concentrate.

BOISE COUNTY.

Mine production in Boise County, Idaho, in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	24	40,830	$418,450	14,883	3,208	1,015	$435,770
1920	13	35,525	265,795	8,783	26	1,650	275,505
Increase or decrease, 1920	−11	−5,305	−152,655	−6,100	−3,182	+635	−160,265

[a] Includes placer production.

The output of gold in Boise County decreased nearly 37 per cent in 1920. Eight deep mines produced ore that averaged $7.71 a ton. Nearly all this ore was treated in gold and silver mills, and the bullion was valued at $206,644.

The production of gold and silver in the county from 1863 to the end of 1920 was $53,013,377 in gold and 2,205,110 ounces of silver.

Boise Basin district (*Placerville, Quartzburg, Idaho City*).—Seven deep mines and five placers in the Boise Basin district produced 35,490 tons of ore, $265,380 in gold, 8,773 ounces of silver, 1,650 pounds of lead, and a little copper, valued in all at $275,079. The ore had an average value of $7.71 a ton. As in other recent years, the Gold Hill & Iowa Mines Co., at Quartzburg, was the largest producer of gold in the district. Most of the gold was saved by amal-

[2] Federal Mining & Smelting Co. Ann. Rept. for year ending Dec. 31, 1920.

gamation, but part of it was contained in concentrates cyanided locally. Five placers produced $1,594 in gold and 21 ounces of silver.

BONNER COUNTY.

The production of Bonner County consisted of three small lots of ore from the Pend Oreille and Lakeview districts. Development work continued at the Keystone property, operated by the Armstead Mines (Inc.). Interesting descriptions of this and other mines of the Pend Oreille district, by Sidney Norman, may be found in the Bonner County number of the Northwest Mining Truth, published in Spokane, Wash., August 4, 1921.

BONNEVILLE COUNTY.

A small production of placer gold came from the American placer, in the Mount Pisgah district.

BOUNDARY COUNTY.

Moyie Yahk district.—Development work continued at the Buckhorn mine, and preparation for hydraulic mining was in progress at the Idaho Gold & Ruby property.

Porthill district (*Klockmann*).—The Idaho Continental mine was active six months of the year and shipped lead ore and concentrate to International, Utah. The concentrate contained about 60 per cent of lead, and the production was greater than that of any mine outside of the Coeur d'Alene region. The mill is run as long as water lasts, and the concentrate is hauled by auto trucks when the condition of the road permits.

CAMAS COUNTY.

Several lots of lead ore containing gold and silver were shipped by the Associated Mines Co., operating near Fairfield.

CLEARWATER COUNTY.

Five placers in Clearwater County produced $7,385 in gold and 89 ounces of silver in 1920. The value of the output decreased 37 per cent from 1919. All the gold came from the Pierce district, and most of it was recovered by dredging.

CUSTER COUNTY.

There was a large increase in the output of Custer County in 1920, and the value of the production was greater than any other county but Shoshone.

Alder Creek district (*Mackay*).—Seven deep mines in the Alder Creek district produced 22,238 tons of ore, containing $28,890 in gold, 88,771 ounces of silver, 1,498,505 pounds of copper, and 1,336,376 pounds of lead, valued in all at $508,285, or $22.86 a ton. A large quantity of lead ore was shipped from the White Knob, Horseshoe, and Doughboy mines, and the largest production of the district, which was a mixed sulphide and oxidized ore, mined by lessees, came

from the Empire mine. The company did considerable work in sinking shafts and developing the ninth and tenth levels.

Bayhorse district (*Clayton*).—One placer and 7 deep mines in the Bayhorse district produced 5,925 tons of ore, $144 in gold, 255,751 ounces of silver, 75,514 pounds of copper, and 591,662 pounds of lead, valued in all at $340,140, or $57.40 a ton. The largest production of ore, which was valuable principally for its silver, was milled by flotation at the Ramshorn property. Lead ore and concentrate were shipped from the Red Bird mine, operated by the Clayton Mining & Smelting Co.

Sea Foam district.—One lot of oxidized lead ore containing considerable gold was shipped from the Silver King mine.

Yankee Fork district.—The Whynot mine produced some copper-lead ore rich in gold and silver, and the Rough Creek placer was worked for three months.

ELMORE COUNTY.

Two deep mines and one placer in Elmore County produced gold and silver valued at $950. High costs and metallurgic difficulties have prevented active mining at Atlanta.

A little gold and silver bullion resulted from milling tests at the Big Lode mine. The Atlanta, General Pettit, and Minerva mines were idle.

FREMONT COUNTY.

Several lots of oxidized copper ore were shipped from the Skull Canyon mine, near Reno.

GEM COUNTY.

Three deep mines in the West View district produced 61 tons of ore, containing $309 in gold, 6,364 ounces of silver, 4,288 pounds of copper, and 879 pounds of lead, valued in all at $8,105, or $132.87 a ton. The Zula Pearl and Anderson mines produced silver ore.

IDAHO COUNTY.

The total output of Idaho County, which was valued at $4,309, continued to decrease, but the average value of the output from deep mines increased from $8.20 a ton in 1919 to $19.76 a ton in 1920.

Camp Howard district.—A little placer bullion was recovered from the Cape Horn mine, near Whitebird.

Cottonwood district.—The Klondyke claim produced a little placer gold by sluicing.

Elk City district.—The deep mines in the Elk City district were idle in 1920, but some placer gold was recovered at the Red Rock and other claims.

Marshall Lake district (*Burgdorf*).—Development work was continued at the Sherman & Corporal property, formerly a large producer of gold.

Tenmile district.—A small lot of gold bullion was shipped from the New York mine, which was idle most of the year.

Warren district.—Seven placers in the Warren district produced $2,348 in gold and 19 ounces of silver, principally from the Buck Diggings, Carson, Golden Rule, and Lucky Strike claims.

LATAH COUNTY.

The Hard Work placer, in the Hoodoo district, and the Carrico placer, on Gold Creek, were operated a short time by sluicing.

LEMHI COUNTY.

Mine production in Lemhi County, Idaho, in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	28	17,570	$44,299	134,812	156,610	5,675,567	$525,222
1920	19	21,335	32,754	142,010	260,139	5,876,375	705,521
Increase or decrease, 1920..	−9	+3,765	−11,545	+7,198	+103,529	+200,808	+180,299

[a] Includes placer production.

The output in 1920 from deep mines in Lemhi County was valued at $704,099, or an average value of $33 a ton, and the value of the gold and silver content was $8.72 a ton. The placer output in 1920 was valued at $1,422. Most of the ore was shipped directly to smelters and had an average of $53.03 a ton.

Eldorado district (*Salmon*).—A mill was completed at the Harmony mine, and considerable copper concentrate and crude ore were shipped during the year. Mill building was continued at the Pope Shenon mine.

Eureka district.—Several lots of sulphide copper ore were shipped from the Green Horn mine.

Indian Creek district (*Ulysses*).—The Ulysses mine was operated by the Buchanan Mining & Leasing Co., and several thousand tons of ore was treated by amalgamation.

Junction district.—Lead ore and concentrate were shipped from the Sunset property, which was operated about half the year.

Mackinaw district (*Leesburg*).—The production of the Mackinaw district consisted of placer gold from the Hockensmith property and lead ore from the Ringbone Cayuse mine.

McDevitt district.—Copper ore and concentrate were shipped from the Copper Queen mine, near Tendoy.

Pratt Creek district.—Lessees operated the Climax mine and produced gold bullion and lead concentrate.

Spring Mountain district.—The Lemhi Union and Excelsior properties produced several lots of oxidized lead ore. The Idaho Mineral Co. erected a 50-ton concentration mill for the treatment of ore from the Iron Mask property.

Texas district (*Gilmore*).—Three deep mines in the Texas district produced 13,000 tons of ore, containing $12,746 in gold, 135,653 ounces of silver, 59,669 pounds of copper, and 5,586,233 pounds of lead, valued in all at $618,486, or $47.58 a ton. The Pittsburg-Idaho mine was

the largest producer of lead ore, and a 40-ton concentration mill was erected during the year. The Latest Out and Gilmore properties produced oxidized lead ore, and the Gilmore also produced several lots of iron ore containing considerable gold.

Unorganized district.—Two shipments of lead ore were made from the Cabin property.

OWYHEE COUNTY.

The ore from deep mines in Owyhee County had in 1920 a value of $190.36 a ton, practically all of which was for gold and silver. The production of gold and silver in the county in 1920 was valued at $19,165 and from the discovery of gold in 1863 to and including that of 1920 was $21,658,868 in gold and 24,453,938 ounces of silver, having a total value of $40,518,290.

Carson district (Silver City).—Five deep mines in the Carson district produced 96 tons of ore, containing $1,998 in gold and 15,498 ounces of silver. Several small lots of silver ore were shipped from or milled in the Carson district, but most of the production was contained in concentrates shipped by the Florida Mountain Mines Co.

SHOSHONE COUNTY.

Mine production in Shoshone County, Idaho, in 1919 and 1920.

Year.	Number of producers.		Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
	Deep mines.	Placers.	*Short tons.*		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	33	5	1,308,063	$179,582	4,815,200	1,474,642	167,666,932	15,994,229	$15,900,815
1920	36	3	1,822,488	121,900	6,386,663	571,119	236,210,301	27,932,326	28,347,791
Increase or decrease, 1920	+3	−2	+514,425	−57,682	+1,571,463	−903,523	+68,543,369	+11,938,097	+12,446,976
Total, 1884–1920	....	....	.....	6,155,331	184,752,844	72,806,725	[b] 2,988,622	422,239,310	487,299,838

[a] Includes placer production of $95,775 in gold and 900 ounces of silver in 1920.
[b] Short tons.

Shoshone County, or the Coeur d'Alene region, is the most important mining center of Idaho. As it includes several mining districts, the production of these is given separately. The average value of the ore from deep mines in 1920 was $15.50 a ton, and the value in gold and silver was $3.83 a ton. The kinds of ore and the contents of each kind have been given in the preceding tables. Most of the ore was milled and yielded concentrates valued at $87.47 a ton. Concentrates consisted of 237,273 tons of lead concentrates and 30,942 tons of zinc concentrates. Seventeen milling plants, having a combined daily capacity of approximately 6,645 tons, were active during the greater part of the year. These mills were concentration plants and 14 of them had flotation equipment.

Of the county ores treated or shipped, 64,545 tons was first-class crude ore, of which 21 tons was siliceous ore, 63,105 tons was lead ore, and 1,419 tons was zinc ore.

Beaver district.—The statement to the county assessor for the Callahan Zinc-Lead Co. gave $1,876,974 as the gross value of the ore. The net profit was $268,746, and dividends were $755,606. The following paragraphs are taken from the company's report:[3]

During the past year of operation our reduction plant exceeded all expectations in point of recovery and efficiency. The average metallic content of our zinc product during the latter part of the period was raised to over 53 per cent zinc, while the lead content was reduced to 2.7 per cent, which compares with slightly below 48 per cent zinc and 5.7 per cent lead in the previous year. * * *

The scarcity of mine labor, coupled with a high wage scale and low efficiency during the past year, and the necessity of using all available men to mine ore in the stopes, made it inadvisable to attempt extensive new development work during the period. However, the main shaft was continued to the No. 10 level and the crosscut driven on this level to cut the vein, which was found to be more promising on this level than on the preceding one. The work of drifting on this vein is now in progress, and to date the drift has been extended for a length of 100 feet on good zinc-lead ore, averaging about 4 feet in width. As soon as the drifts, both east and west, are completed, raises will be driven through the ore to the No. 9 level above, and the main shaft will be sunk another 200 feet to the No. 11 level below. * * *

During the past year your company has consummated the purchase of a controlling interest (51 per cent) in the Chicago Boston Mining Co. and also controlling interest (80 per cent) in the Killbuck Mining Co. (Ltd.), both of which are lead-silver properties, the former owning approximately 280 acres and the latter about 100 acres, located about 2 miles from Wallace. * * *

During 1920 172,930 tons of ore was mined, of which 128,781 tons was milled. The mill ore averaged 2.58 ounces of silver per ton and contained 7.37 per cent of lead and 14.79 per cent of zinc. The lead ore and concentrate (11,970 tons) contained 237,523 ounces of silver and 13,953,182 pounds of lead, as well as zinc not paid for. The zinc ore and concentrate (28,826 tons) contained 50,965 ounces of silver, 2,047,388 pounds of lead, and 29,845,344 pounds of gross zinc.

Coeur d'Alene district.—The Yukon Gold Co. operated its dredge near Murray most of the year, handled 1,295,900 cubic yards of gravel, and produced gold valued at $96,331, according to the statement of the county assessor. The net profit was $16,683, which was a decrease from the profit for 1919. Unfortunately no production was made in June and July on account of the sinking of the dredge.

Eagle district.—Several lots of high-grade lead ore were shipped from the Jack Waite and Holt mines.

Evolution district.—Five deep mines produced 792 tons of ore, containing $32 in gold, 31,132 ounces of silver, 3,834 pounds of copper, and 301,904 pounds of lead, valued in all at $58,824, or $74.27 a ton. Most of the output was lead ore from the Western Union and Yankee Boy mines.

Hunter district (Mullan).—Three deep mines in the Hunter district produced 452,901 tons of ore, containing $4,816 in gold, 1,278,171 ounces of silver, 33,000 pounds of copper, 44,168,868 pounds of lead, and 1,841,227 pounds of recoverable zinc, valued in all at

[3] Callahan Zinc-lead Co. Eighth Ann. Rept., for year ending Dec. 31, 1920.

$5,086,742, or $11.23 a ton. Most of the ore was milled and reduced to 43,731 tons of concentrates, which, with 15,835 tons of crude ore, was shipped to smelting plants. From the Morning mine, owned by the Federal Mining & Smelting Co., lead ore and concentrate were shipped to East Helena, Mont., and zinc concentrate to Colorado and Oklahoma. According to the statement to the county assessor, 314,027 tons of ore was mined, which had a gross value of $3,293,721. The net profit was $568,072. Dividends declared by the Federal Mining & Smelting Co. from all properties amounted to $719,167.

The company [4] operated the Morning mine, near Mullan, the Frisco mine at Gem, mines at Mace and Burke, also the Independence-North Star group, in Blaine County, and mines in Kansas and Oklahoma. During the year the Tiger-Poorman mine at Burke was sold to the Hecla Mining Co. Receipts show that the Morning mine was more profitable than all the other property, though it was operated at a loss in December. The 1,000-ton mill at Morning was active, but the 500-ton plant near Wallace was idle. The mine is opened to a depth of approximately 3,000 feet from the surface by a winze 1,250 feet deep from the adit level. Fully developed ore reserves, exclusive of ore in the Star ground, which is in litigation, consisted of 625,000 tons of milling ore, equal to about 131,890 tons of lead and zinc products. The report continues:

> The first half of the year was quite profitable and satisfactory. Beginning with the middle of the year, the prices of lead and zinc began a continuing fall until, at the close of the year, they were, relative to cost of production, at less than prewar levels. * * * The situation with zinc is practically the same as in the case of lead. * * *

Lead concentrate was shipped from the Gold Hunter mine, which was active throughout the year. According to the statement to the county assessor, 160,027 tons of ore was mined, having a gross value of $1,236,732. The net profit was $115,833. The 500-ton milling plant was active throughout the year.

Lelande district (Burke, Mace, Frisco).—Six deep mines in the Lelande district produced 478,137 tons of ore, containing $8,641 in gold, 2,561,292 ounces of silver, 266,000 pounds of copper, 80,630,638 pounds of lead, and 506,146 pounds of recoverable zinc, valued in all at $9,340,842, or $19.53 a ton. Shipments from the district consisted of 62,241 tons of concentrates and 27,425 tons of crude ore, principally lead products. The main producers were the Hercules, Hecla, Frisco, and Mace and Burke mines of the Federal Mining & Smelting Co. The Hercules mine produced lead ore shipped from Burke and milling ore treated at the company's plant near Wallace. According to the statement to the county assessor, 52,435 tons of crude ore and concentrate was shipped, which had a gross value of $5,337,360. The net profit was $1,147,706, and dividends, which were estimated, amounted to $850,000. Nearly all the ore and concentrate was smelted at Northport, Wash.

The Hecla mine was operated throughout the year and shipped crude ore and concentrate to the Bunker Hill smelter. According to the statement to the county assessor, 229,893 tons of ore was mined,

[4] Federal Mining & Smelting Co. Ann. Rept., for year ending Dec. 31, 1920.

which had a gross value of $3,181,965. The net profit was $1,093,602. The following notes are taken from the printed report[5] of the company:

A total of 4,731 feet of development work was done during the year, 2,229 feet of drifts and 2,502 feet of crosscuts and raises. * * *

Development of the 2,000-foot level was continued, and during the year the drift was advanced 842 feet with the face still in good ore. The result of this development has been very gratifying. The ore is of good quality and the vein of more than the average width and well filled with ore. Our ore reserves are estimated at 2,095,745 tons. * * *

We have made a settlement with the Federal Mining & Smelting Co. of the suit for possession of our east ore body. This settlement provided for the purchase by the Hecla Mining Co. of the Tiger-Poorman property of the Federal Co., which adjoins the Hecla Co.'s ground, including the Russell lode mining claim, which claim the Federal Co. asserted contained the apex to our east ore body. It also includes a valuable water right at Burke, which is being used at present for the generation of electric power. * * *

Dividends paid during the year amounted to $650,000 and total dividends to the end of the period are $8,505,000. * * *

Of the ore mined, 185,275 tons was milled, making 23,518 tons of concentrate. This, with 10,682 tons of crude ore was smelted and contained 924,179 ounces of silver and 33,717,468 pounds of lead.

The production of the Hecla Mining Co. for 17 years was 449,326 tons of crude ore and concentrate, containing 12,934,313 ounces of silver, 447,595,771 pounds of lead, and 941,229 pounds of gross zinc.

Lessees operated the mines at Frisco, Mace, and Burke owned by the Federal Mining & Smelting Co., and shipped more than 5,000 tons of crude lead ore and zinc ore.

Placer Center district (*Sunset*).—Seven deep mines in the Placer Center district produced 145,435 tons of ore, containing $2,356 in gold, 531,555 ounces of silver, 68,500 pounds of copper, 17,662,653 pounds of lead, and 178,011 pounds of recoverable zinc, valued in all at $2,021,786, or $13.90 a ton. Of the district output, 4,435 tons was crude ore and 19,250 tons concentrates. Shipments were made from the Chicago-Boston, Rex, Black Cloud, Silver Eagle, and Sister mines, but most of the output came from the Tamarack & Custer and Success properties. The Success mine was operated for only a short time, as the freight and treatment charge on zinc ore was prohibitive. According to the statement made to the county assessor, the Tamarack & Custer property produced 22,889 tons of crude ore and concentrate, which had a gross value of $1,711,658. The net profit was $169,371 and estimated dividends were $75,000. The output was shipped to Northport, Wash., for smelting.

Summit district (*Murray*).—The output of the Summit district from two deep mines and one placer was 1,530 tons of ore, $95 in gold, 2,943 ounces of silver, and 586,986 pounds of lead, valued in all at $50,262. Crude ore and concentrate were shipped from the Monarch and Bear Creek properties.

Yreka district (*Kellogg*).—Ten deep mines in the Yreka district produced 613,476 tons of ore and tailings, containing $10,196 in gold, 1,705,740 ounces of silver, 199,785 pounds of copper, 77,968,370 pounds of lead, and 38,400 pounds of zinc, valued in all at $8,146,793, or $13.28 a ton. Shipments consisted of 102,834 tons of concentrates and 14,737 tons of crude ore. As in former years, the largest pro-

[5] Hecla Mining Co. Ann. Rept. for year ending Dec. 31, 1920.

ducer of the district and the largest producer of lead in the State was the Bunker Hill & Sullivan Mining & Concentrating Co. Other large producers were the Mullan Milling, Caledonia, Thornsdon Metals, Nabob, Hayes, Big Creek, and Sierra Nevada properties. According to the statement to the county assessor, the Sierra Nevada mine produced 10,877 tons of ore, which had a gross value of $248,860. The net profit was $99,765. Lead concentrate was shipped from the Big Creek mine, on which a 75-ton concentration plant was constructed during the year. Old tailings were re-treated by the Mullan Milling Co., the Thornsdon Metals Saving Co., and the Hayes Co. The ore deposit of the Caledonia property is nearly exhausted, but 14,318 tons of mine ore and dump ore was smelted, which had a gross value of $481,932. The net profit was $223,371 and dividends were $208,400. The company[6] produced 304,197 ounces of silver and 2,019,326 pounds of lead, and the surplus was $344,795.

The Bunker Hill mine was active throughout the year and shipped lead concentrate to the Bunker Hill smelter and various plants of the American Smelting & Refining Co. According to the statement to the county assessor, 409,986 tons of ore was mined, which had a gross value of $6,915,140. The net profit was $2,662,315, and dividends were $1,962,000. Extracts from the printed report[7] follow:

Improvement in the labor supply, especially during the latter part of 1920, made possible an increased yield from the mines for the year. * * *

During the early part of the year the metal market was strong, but declined until at the end of the year it was comparatively low. Operating costs reached their maximum during the year 1920. * * *

Operations at the Bunker Hill smelter and refinery were conducted continuously throughout the year with satisfactory results in every respect. But for short intervals * * * two furnaces were in operation during the year.

Further development of the ore on No. 15 level was conducted, and mining operations begun there have borne out in every way our expectations of the ore on this level, which in grade, purity, and extent fully equals, and doubtless exceeds, the ore heretofore found on any former level. * * *

We have blocked out to date 4,762,437 tons of ore. * * *

The mine was in operation for the full period of 12 months and produced 409,986 tons of concentrating ore at a cost of $1,307,587. * * *

The West mill concentrators were in operation for the full year, during which 25 days were lost. * * *

During the year 415,257 tons of mine ore were concentrated, making the average work of the concentrators 1,134 tons per day, or, say, 1,218 tons per 24 hours of actual operation, at a cost of $348,535. * * *

The Sweeney mill was operated on tailings during the year, treating 107,850 tons at a total cost of $61,037.84; 7,027.12 tons of concentrates were produced, the gross value of which is included in production tables of this report. * * *

The ore milled, 409,715 tons, contained 9.97 per cent of lead and 3.67 ounces of silver to the ton. From this ore 89,192 tons of concentrates and middlings was produced, containing 69,515,508 pounds of lead and 1,161,695 ounces of silver. Crude ore (271 tons) contained 1,457 ounces of silver and 57,354 pounds of lead, and the Sweeney mill concentrates contained 31,327 ounces of silver and 1,499,126 pounds of lead. The total cost per pound of lead was 5.73 cents. From 1886 to 1920 the company has mined 9,079,597

[6] Caledonia Mining Co. statement for year ending Dec. 31, 1920.
[7] Bunker Hill & Sullivan Mining & Concentrating Co. Thirty-third Ann. Rept., for year ending Dec. 31, 1920.

tons of ore having a gross value of $98,350,625. Net smelter returns were $58,346,138, and operating profit was $33,469,717. An interesting series of articles by Rickard,[8] continued through 1920, gave the history of the Bunker Hill mine, a discussion of the geology of the property, methods of mining, and the milling practice at the different plants.

VALLEY COUNTY.

Most of the placer output in Valley County resulted from sluicing the decomposed ledge of the Dewey mine in the Thunder Mountain district.

WASHINGTON COUNTY.

Siliceous silver ore containing copper was shipped from the Egan mine.

[8] Rickard, T. A., The Bunker Hill enterprise: Min. and Sci. Press, vol. 120, pp. 5, 41, 109, 185, 261, 337, 485, 521, 703, 791; vol. 121, pp. 195, 335.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON.[1]

(MINES REPORT.)

By C. N. Gerry.

PRODUCTION.

SUMMARY.

The value of the mine production of gold, silver, copper, lead, and zinc in Washington in 1920 was about 24 per cent more than in 1919. The output of gold and silver was less, but that of copper and lead was more, and the mining of zinc ore was resumed.

One company paid dividends which aggregated $142,875 in 1920, but these were paid from the earnings of former years.

Mine production of gold, silver, copper, lead, and zinc in Washington in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	49	100,879	$252,862	259,384	1,676,576	2,146,157	.....	$968,961
1920	44	85,318	120,860	199,678	1,983,134	5,787,247	426,496	1,200,932
Increase or decrease, 1920	−5	−15,561	−132,002	−59,706	+306,558	+3,641,090	+426,496	+231,971
Total, 1860–1920	.....	.....	28,127,072	7,822,595	16,504,916	40,462,323	3,620,166	40,123,980

ORE.

The quantity of ore sold or treated in Washington decreased more than 15 per cent in 1920. The output from Snohomish County nearly doubled, but that of Ferry and Stevens counties was much less. The average value per ton of the ore increased from $9.59 in 1919 to $14.06 in 1920, but the value per ton in gold and silver decreased from $5.37 to $3.95. Of the total output of ore more than 15 per cent was dry or siliceous ore, nearly 74 per cent copper ore, and more than 10 per cent lead ore.

[1] The figures of production used in this report were tabulated and the statistical tables compiled by B. N. Patchell, of the United States Geological Survey.

The siliceous ore was composed of 12,513 tons of gold ore, averaging per ton $9.10 in gold, 2.45 ounces of silver, and a trace of copper; and 583 tons of silver ore, averaging per ton $1.38 in gold and 26.34 ounces of silver. The total siliceous ore averaged per ton $8.76 in gold, 3.51 ounces of silver, and a trace of copper and lead. Copper ore as mined averaged 7 cents in gold and 2.34 ounces of silver to the ton and 1.57 per cent of copper, or a total value per ton of $8.41. Lead ore averaged 33.22 per cent of lead, or a value per ton of $53.68; and zinc ore averaged 32.64 per cent of zinc, or a value per ton of $52.88. Most of the copper ore was concentrated but other ores were shipped without treatment.

Ore and metals produced in Washington in 1920.

Source of production.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Placers	9	.....	71.20	16	.....	.....	.....
Dry or siliceous ore	15	13,096	5,549.82	45,977	2,073	1,743	.....
Copper ore	8	62,814	223.59	146,820	1,975,604	.....	.....
Lead ore	10	8,660	1.99	4,123	.....	5,753,976	.....
Zinc ore	1	630	.....	.....	.....	.....	411,264
Copper-lead ore	1	90	.....	2,742	5,457	25,708	.....
Lead-zinc ore	1	28	.....	.....	.....	5,820	15,232
	.....	85,318	5,846.60	199,678	1,983,134	5,787,247	426,496

Ore sold or treated from Washington in 1920, by counties, in short tons.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Chelan	.....	.....	.....	.....	.....	.....	4
Ferry	12,431	57	.....	.....	.....	.....	12,488
King	63	.....	.....	.....	.....	.....	63
Okanogan	572	156	39	.....	90	.....	857
Snohomish	.....	25,008	.....	.....	.....	.....	25,008
Stevens	18	37,593	8,621	630	.....	28	46,890
Whatcom	8	.....	.....	.....	.....	.....	8
	[a] 13,096	62,814	8,660	630	90	28	85,318
Average value per ton in gold and silver	$12.59	$2.62	$0.52	.....	$33.21	.....	$3.95

[a] Includes 12,513 tons of gold ore and 583 tons of silver ore.

Seven milling plants were active in 1920, and five new mills were under construction. Concentration equipment of various types was used in six of the active mills, of which one was a flotation mill and four used flotation cells after table concentration. Only one small cyanide plant was operated. Most of the ore milled was treated at the United Silver-Copper plant, at Chewelah, and the Sunset plant, near Index.

Ore and concentrate from mines in Washington were smelted at Tacoma and Northport, Wash., and Trail, British Columbia. Early in the year some lead ore was shipped to Midvale, Utah. The lead plant at Northport was active most of the year and doubled its output of lead bullion. The Tacoma smelter continued to operate, but not at full capacity.

More than 72 per cent of the output of ore was concentrated and produced 4,106 tons of concentrates. The greater part was copper concentrate from the Chewelah district, Stevens County, and the Index district, Snohomish County. Siliceous concentrates averaged $23.94 in gold and 174.18 ounces of silver to the ton and had an average value per ton of $213.77. Copper concentrates averaged $1.03 in gold and 23.59 ounces of silver to the ton and 21.32 per cent of copper, and had an average value per ton of $105.19.

Mine production of metals from Washington concentrates in 1920.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	
King	35	7	13.10	116	.....	$398
Okanogan	540	49	6.60	3,580	1,720	4,355
Snohomish	24,703	1,745	144.90	13,811	1,085,701	217,818
Stevens	36,361	2,305	59.00	81,904	655,974	211,194
	61,639	4,106	223.60	99,411	1,743,395	433,765

By kinds of concentrates.

Dry or siliceous	.....	17	19.70	2,961	.....	$3,634
Copper	.....	4,089	203.90	96,450	1,743,395	430,131

Nearly 28 per cent of the ore was mined and shipped directly to smelters, and most of it came from Ferry and Stevens counties. Of the shipping ore, nearly 54 per cent was dry or siliceous, nearly 7 per cent was copper ore, and nearly 37 per cent was lead ore. The siliceous ore shipped to smelters averaged $8.99 in gold, 3.4 ounces of silver, and was valued at $12.73 a ton. Copper ore shipped averaged 25 cents in gold and 31.6 ounces of silver to the ton and 7.28 per cent of copper and was valued at $61.50 a ton. All the lead ore and zinc ore was shipping ore, the averages of which have already been given.

Most of the copper ore shipped, 1,570 tons, was sulphide, but most of the first-class lead ore, 7,229 tons, was oxidized. The zinc ore and lead-zinc ore were both oxidized.

Mine production of metals from Washington crude ore shipped to smelters in 1920.

By counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Ferry	12,488	5,334.70	33,274	4,113	.....	.....	$147,304
King	28	41.90	577	.....	.....	.....	1,495
Okanogan	317	115.22	13,427	7,530	33,838	.....	21,110
Snohomish	305	.70	837	36,212	.....	.....	7,590
Stevens	10,529	37.97	52,133	191,884	5,753,409	426,496	587,735
	23,667	5,530.49	100,248	239,739	5,787,247	426,496	765,234

Mine production of metals from Washington crude ore, etc.—Continued.

By kinds of ore.

Ore.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Dry or siliceous	12,665	5,508.79	43,013	2,073	1,743	.....	$161,282
Copper	1,594	19.70	50,370	232,209	.....	.....	98,037
Lead	8,660	2.00	4,123	.....	5,753,976	.....	464,853
Zinc	630	.....	.....	.....	.....	411,264	33,312
Copper-lead	90	.....	2,742	5,457	25,708	.....	6,050
Lead-zinc	28	.....	.....	.....	5,820	15,232	1,700

GOLD.

The mine production of gold in Washington decreased 52 per cent in 1920. Nearly 95 per cent of the gold was obtained from ores shipped directly to smelters, more than 1 per cent from placers, and nearly 4 per cent from concentrates. The table below shows that siliceous ore continued to supply most of the gold. The Quilp and Surprise mines, at Republic, were the largest producers of gold in 1920. No ore was treated by amalgamation or cyanidation, except for small mill tests.

Mine production of gold in Washington in 1920, by counties, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Total.
Chelan	.....	1.31	.....	.....	1.31
Clallam	12.43	.....	.....	.....	12.43
Ferry	.....	5,334.70	.....	.....	5,334.70
King	.....	55.00	.....	.....	55.00
Kittitas	52.00	.....	.....	.....	52.00
Okanogan	1.69	119.82	.....	1.99	123.50
Snohomish	.....	.....	145.61	.....	145.61
Stevens	.....	18.96	77.98	.....	96.94
Whatcom	5.08	20.03	.....	.....	25.11
	71.20	[a] 5,549.82	223.59	1.99	5,846.60

[a] Includes 5,510.88 ounces from gold ore and 38.94 ounces from silver ore.

SILVER.

The mine production of silver in Washington decreased 23 per cent in 1920. Stevens County had the largest production, and Ferry and Okanogan counties followed. Crude ore shipped to smelters supplied more than 50 per cent of the silver, and concentrates nearly all the remainder. Copper ore contained nearly 74 per cent of the silver, and siliceous ore more than 23 per cent. The United Silver-Copper, Quilp, and Sunset mines produced most of the silver in Washington.

Mine production of silver in Washington in 1920, by counties, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Total.
Clallam	1	.....	.....	.....	.....	1
Ferry	.....	33,172	102	.....	.....	33,274
King	.....	693	.....	.....	.....	693
Kittitas	15	.....	.....	.....	.....	15
Okanogan	.....	11,929	735	1,601	2,742	17,007
Snohomish	.....	.....	14,648	.....	.....	14,648
Stevens	.....	180	131,335	2,522	.....	134,037
Whatcom	.....	3	.....	.....	.....	3
	16	[a] 45,977	146,820	4,123	2,742	199,678

[a] Includes 30,618 ounces from gold ore and 15,359 ounces from silver ore.

COPPER.

The mine production of copper in Washington increased more than 18 per cent in 1920, and the increase was almost entirely in Snohomish County. Concentrates, principally from copper ore, yielded nearly 88 per cent of the copper. The only large producers were the Sunset property, near Index, and the United Silver-Copper mine, northeast of Chewelah.

Mine production of copper in Washington in 1920, by counties, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Copper-lead ore.	Total.
Ferry	.....	4,113	.....	4,113
Okanogan	2,073	1,720	5,457	9,250
Snohomish	.....	1,121,913	.....	1,121,913
Stevens	.....	847,858	.....	847,858
	[a] 2,073	1,975,604	5,457	1,983,134

[a] From silver ore.

LEAD.

The mine production of lead in Washington, most of it from the Electric Point mine in the Northport district, Stevens County, was more than doubled in 1920. All the lead ore was first-class smelting ore, of which 7,229 tons was carbonate ore containing 3,918,884 pounds of lead.

ZINC.

The output of recoverable zinc in Washington in 1920 was 426,496 pounds, valued at $34,546. Carbonate ore was mined from the Northwest mine, a new deposit in the Northport district, Stevens County.

MINING INDUSTRY.

Though the ouput of some of the metal mines in Washington was greater in 1920 than in 1919, mining was not generally profitable. Most of the ore mined is low-grade material which will not bear the current high cost of mining, milling, shipping, smelting, and refining. Several of the copper, lead, and zinc mines made a fair showing, but they were unable to operate at full capacity throughout the year. The mining of gold ore continued to decrease as the expense of mining and milling low-grade gold ore was prohibitive. Comparatively little gold ore was shipped from Republic on account of high costs and also of difficulties resulting from litigation.

Mine production of gold, silver, copper, lead, and zinc in Washington in 1920, by counties.

County.	Ore.	Gold.		Silver.	
		Quantity.	Value.	Quantity.	Value.
	Short tons.	*Fine ounces.*		*Fine ounces.*	
Chelan	4	1.31	$27		
Clallam		12.43	257	1	$1
Ferry	12,488	5,334.70	110,278	33,274	36,269
King	63	55.00	1,137	693	756
Kittitas		52.00	1,075	15	16
Okanogan	857	123.50	2,553	17,007	18,538
Snohomish	25,008	145.61	3,010	14,648	15,966
Stevens	46,890	96.94	2,004	134,037	146,100
Whatcom	8	25.11	519	3	3
	85,318	5,846.60	120,860	199,678	217,649

County.	Copper.		Lead.		Recoverable zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Chelan							$27
Clallam							258
Ferry	4,113	$757					147,304
King							1,893
Kittitas							1,091
Okanogan	9,250	1,702	33,838	$2,707			25,500
Snohomish	1,121,913	206,432					225,408
Stevens	847,858	156,006	5,753,409	460,273	426,496	$34,546	798,929
Whatcom							522
	1,983,134	364,897	5,787,247	462,980	426,496	34,546	1,200,932

Ore sold or treated, deep mines producing, and average value of ores in Washington in 1919 and 1920, by counties.

County.	Ore sold or treated, 1920.		Number of deep mines producing.		Average total value per ton.[a]		Average value per ton in gold and silver.[a]	
	Quantity.	Increase or decrease.	1919	1920	1919	1920	1919	1920
	Short tons.	*Short tons.*						
Chelan	4	— 1	1	1	$13.00	$6.75	$13.00	$6.75
Ferry	12,488	—13,209	9	8	12.44	11.80	12.40	11.73
King	63	— 3	1	1	47.48	30.05	46.11	30.05
Lewis		— 17	1		30.59		4.12	
Okanogan	857	— 2,118	9	6	12.68	29.71	11.28	24.57
Pend Oreille		— 15	1		33.13		28.20	
Pierce		— 24	1		25.37			
Snohomish	25,008	+12,247	4	3	8.75	9.01	.74	.76
Stevens	46,890	—12,429	15	15	8.32	17.04	2.98	3.16
Whatcom	8	+ 8		1		52.13		52.13
	85,318	—15,561	42	35	9.59	14.06	5.37	3.95

[a] Placer product excluded.

Nine placers operated by hydraulic and sluicing methods were active in 1920, and the value of the output was $1,489.

FERRY COUNTY.

Mine production in Ferry County, Wash., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	9	25,697	$245,141	65 684	5,313	143	$319,703
1920	8	12,488	110,278	33,274	4,113	.....	147,304
Decrease, 1920	1	13,209	134,863	32,410	1,200	143	172,399

The quantity of ore mined and the metals produced in Ferry County continued to decrease considerably in 1920. The value of the ore decreased slightly. The entire output, which had a value of $147,304, was shipped directly to smelters. Of the total output, 12,431 tons was siliceous ore and 57 tons was copper ore.

Enterprise district.—Three deep mines in the Enterprise district produced 88 tons of ore, valued at $4,052, or $46.05 a ton. Several lots of silver ore were shipped from the Longstreet mine.

Republic district.—Four deep mines in the Republic district produced 12,343 tons of ore, containing gold valued at $110,069 and 29,647 ounces of silver, valued together at $142,384, or $11.53 a ton. No mills were operated in the district, and all the ore was shipped to smelters. From 1896 to the end of 1920 the Republic district produced 549.198 tons of ore, containing $7,045,680 in gold and 2,069,444 ounces of silver, valued together at $8,311,646. The Quilp mine was the largest producer, but little mining was done as most of the ore had been broken down in 1919. The Last Chance Mining Co. was idle, and few shipments were made from the group of mines belonging to the Northport Smelting & Refining Co. Litigation between these companies was settled in November in favor of the Last Chance Co. Other producers were the San Poil and Knob Hill mines.

KING COUNTY.

The Apex mine produced ore containing gold, silver, and arsenic, part of which was concentrated.

KITTITAS COUNTY.

Four placers in the Swauk district produced gold and silver valued at $1,091. The Weininger property, on Boulder Creek, was operated four months by drifting.

OKANOGAN COUNTY.

Six deep mines and two placers in Okanogan County produced 857 tons of ore, $2,553 in gold, 17,007 ounces of silver, 9,250 pounds of copper, and 33,838 pounds of lead, valued in all at $25,500. The quantity of ore sold or treated decreased 2,118 tons, but the value of the ore increased from $12.68 a ton in 1919 to $29.71 in 1920.

Conconully district.—Silver ore from the Arlington mine was smelted at Tacoma, Wash., and copper-lead ore from the Last Chance mine was shipped to Bradley, Idaho.

Meyers Creek district.—A few lots of gold ore were shipped from Chesaw, and iron ore from the Neutral mine was shipped to Chewelah for the manufacture of ferromagnesite.

Nespelem (Moses) district.—Several lots of rich silver ore and concentrate were shipped from the Apache mine. The milling ore was treated at the custom plant of the Great Western Milling Co. The product is hauled 37 miles to Almira, on the Northern Pacific Railway.

Palmer Mountain district.—Some copper ore from the Kaaba mine was concentrated at the Bender custom plant at Nighthawk, and one lot of lead ore was shipped from the Copper World Extension mine.

PIERCE COUNTY.

No ore was treated or smelted from Pierce County in 1920, but local and foreign custom ore was treated at Tacoma, where the copper smelter and refinery were operated at reduced capacity.

SNOHOMISH COUNTY.

Three deep mines in Snohomish County produced 25,008 tons of ore valued at $225,408, an increase of 12,247 tons in quantity and $113,678 in value. The entire output was copper ore, and most of it was milled. The value per ton increased from $8.75 in 1919 to $9.01 in 1920.

Index district.—The Sunset Copper Co. produced more copper than any other mine in the State, though the mill was operated at full capacity only from January 1 to August 15. Table and flotation concentrates were shipped to Tacoma, Wash.

Sultan district.—A test lot of oxidized copper ore was shipped from the Sultan mine.

STEVENS COUNTY.

Mine production in Stevens County, Wash., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	15	59,319	$1,434	156,562	1,109,371	2,086,743	.....	$493,724
1920	15	46,890	2,004	134,037	847,858	5,753,409	426,496	798,929
Increase or decrease, 1920	.....	−12,429	+570	−22,525	−261,513	+3,666,666	+426,496	+305,205

There was a good increase in the production of lead and zinc in Stevens County. The value per ton of the ore increased from $8.32 in 1919 to $17.04 in 1920. Most of the ore was milled and yielded concentrates valued at $91.62 a ton; the remainder was shipped directly to the smelters and had a value of $55.82 a ton.

Bossburg district.—Sulphide lead ore was shipped from the Bonanza mine.

Chewelah district.—From 1901 to the end of 1920 the Chewelah district has produced 355,379 tons of ore, yielding $72,103 in gold, 1,365,392 ounces of silver, 8,580,034 pounds of copper, and 265,139 pounds of lead, having a total value of $2,858,176. Two deep mines in 1920 produced 37,493 tons of ore, valued at $299,067, or an average of $7.98 a ton. The United Silver-Copper Mining Co. continued to mill and ship copper ore, but the output of silver and copper was greatly reduced. No development work was done during the year, but more than 3,000 tons of crude copper ore and concentrate was shipped to Tacoma. The company printed no annual report for 1920.

Loon Lake district.—The Loon Lake mine was idle in 1920, but one lot of copper concentrate from previous operations was shipped early in the year.

Northport district.—Nine deep mines in the Northport district produced 9,119 tons of ore, which contained 1,811 ounces of silver, 5,685,681 pounds of lead, and 426,496 pounds of recoverable zinc, valued in all at $491,375, or $53.88 a ton. Most of the lead ore was mined at the Electric Point property, which produced first-class sulphide and carbonate ore for shipping and low-grade carbonate ore which was held for local treatment. The operating income in 1920 was $265,074, and the loss was $23,573. Dividends paid from capital amounted to $142,875. The mine is opened by 9,680 feet of drifts and shafts. Seven cars of lead ore were shipped from the Gladstone Mountain mine and several lots from the Last Chance mine. At the Lead Trust mine a concentration mill was being constructed for the treatment of lead ore. The Northwest mine on Deep Creek, northeast of Northport, produced several hundred tons of carbonate zinc ore which was shipped East.

The Northport Smelting & Refining Co. operated the lead plant at Northport at full capacity nine months of the year and treated lead ore and concentrate from Idaho and Washington.

WHATCOM COUNTY.

A test lot of gold ore was treated by cyanidation at the Azurite mine, in the Slate Creek district.

MANGANESE AND MANGANIFEROUS ORES.

By H. A. C. Jenison.

GENERAL CONDITIONS.

The curtailment of the production of steel and the general depression of industry which began in 1919 continued through 1920 with greater effect upon the domestic manganese industry than during the preceding year.

The total domestic shipments were greater in 1920 than in 1919, and the increase in high-grade ore was due to the greatly increased shipments from the Butte district, Montana. The value of the total shipments indicates a much lower average price than was realized in 1919. The average value of the Montana shipments in 1920 also represents a marked decrease, although it is appreciably higher than the average of the remainder of the shipments.

The conditions governing production at Butte and Philipsburg are not comparable to those in any other district. The principal part of the Montana output was derived from a mine which was developed primarily for zinc and which still produces a considerable quantity of zinc. Furthermore the company that operates the mine smelts most of the ore at a relatively short distance from the mine, thus eliminating long, expensive railway hauls of the ore and the handling costs and profits of an intermediate group in the industry. The ore is reported to carry considerable recoverable silver and the notable silver content of ore from the other districts in Montana is a marked advantage not possessed by the ores in most districts outside of Montana. Furthermore the ore at Philipsburg, being suitable for chemical and dry battery uses, has a market that is available only to a very few small deposits outside of Montana.

The shipments of manganiferous ore from Minnesota greatly exceeded those of 1919 in spite of the average value being approximately 17.5 per cent less than during that year. The increased shipments and the low average value of the ores shipped from Minnesota suggest an effort on the part of the producers to realize as much of a return upon their expenditures as possible, though the cost of production may have equaled or even exceeded the value of the shipments.

The statistics of shipments for the year are not so significant as the conditions under which the shipments were made or as the efforts of the producers to improve the operating and market conditions.

[1] The statistical tables in this report were prepared by Miss Helena M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the United States Geological Survey.

SUMMARY OF STATISTICS.

Manganese alloys and ore produced in the United States and imported from important foreign sources, 1911–1920, in gross tons.

Year.	Steel.	Ferromanganese.		Spiegeleisen.		Manganese ore.				
	Production.[a]	Shipments.	Imports.	Shipments.	Imports.	Shipments.	Total imports.	Imports from—		
								Russia.	India.	Brazil.
1911	23,676,106	74,602	80,263	104,013	20,970	2,457	176,852	19,103	103,580	41,600
1912	31,251,303	125,378	99,137	102,561	1,015	1,664	300,661	83,334	128,645	81,580
1913	31,300,874	119,495	128,070	106,980	77	4,048	345,090	124,337	141,587	70,200
1914	23,513,030	100,731	82,997	76,625	2,870	2,635	283,294	52,681	103,583	113,924
1915	32,151,036	144,260	55,263	114,556	200	9,613	320,778	.....	36,450	275,579
1916	42,773,680	224,103	90,928	182,837	.....	31,474	576,321	.....	51,960	471,837
1917	45,060,607	260,225	41,969	189,241	3,968	129,405	629,972	.....	48,975	512,517
1918	44,462,432	306,076	27,168	263,861	1,969	305,869	491,303	.....	29,275	345,877
1919	34,671,232	198,255	33,022	90,855	27	55,322	333,344	6,916	9,200	246,592
1920	42,132,934	276,594	59,254	103,672	5,234	94,420	606,937	18,762	71,238	421,523

[a] According to American Iron and Steel Institute.

For a discussion of manganese minerals and ore the reader is referred to the report on manganese and manganiferous ores in 1919.[2]

MANGANESE AND MANGANIFEROUS ORES.

SHIPMENTS.

Manganese and manganiferous ore shipped from mines in the United States in 1919, by States.

State.	Ore containing 35 per cent of manganese or more.			Ore containing 10 to 35 per cent of manganese.			Ore containing 5 to 10 per cent of manganese.		
	Number of shippers.	Quantity (gross tons).	Value.	Number of shippers.	Quantity (gross tons).	Value.	Number of shippers.	Quantity (gross tons).	Value.
Alabama	1	40	(a)	.....	.....	.....	.....	.....	.....
Arizona:									
Used for fluxing	1	18	(a)	1	1,964	(a)	.....	.....	.....
Used for other purposes	4	529	$14,445	.....	.....	.....	.....	.....	.....
Arkansas	5	2,558	60,633	2	564	(a)	.....	.....	.....
California	9	11,289	329,200	.....	.....	.....	.....	.....	.....
Colorado:									
Used for fluxing	.....	.....	.....	[b] 16	18,423	$27,635	9	[c] 11,346	$17,019
Used for other purposes	3	11,166	238,671	[b] 5	11,071	121,421	.....	.....	.....
Georgia	1	48	(a)	1	3,496	(a)	2	230	(a)
Michigan	.....	.....	.....	1	29,296	(a)	.....	.....	.....
Minnesota	.....	.....	.....	8	138,952	546,685	3	106,931	339,311
Montana	6	24,993	993,633	.....	.....	.....	.....	.....	.....
Nevada:									
Used for fluxing	1	347	(a)	2	77,815	(a)	.....	.....	.....
Used for other purposes	1	78	(a)	1	6,225	(a)	1	1,070	(a)
New Mexico:									
Used for fluxing	.....	.....	.....	.....	.....	.....	1	250	(a)
Used for other purposes	.....	.....	.....	2	12,198	(a)	3	4,072	5,073
North Carolina	.....	.....	.....	1	30	(a)	.....	.....	.....
Tennessee	6	328	8,388	1	35	(a)	.....	.....	.....
Virginia	6	3,928	142,431	2	9,765	(a)	.....	.....	.....
Wisconsin	.....	.....	.....	.....	.....	.....	[d] 1	[d] 115,983	(a d)
Undistributed	.....	.....	9,462	.....	.....	486,787	.....	.....	325,365
	44	55,322	1,796,863	[b] 41	309,834	1,182,528	[d] 19	[cd]123,899	[d] 369,964

[a] Included under "Undistributed." Geological Survey not at liberty to publish.
[b] Two shippers of flux in Colorado are also shippers of ore for other purposes in Colorado. These shippers are not duplicated in the total for the United States.
[c] Includes 844 gross tons of ore containing less than 5 per cent of manganese.
[d] Manganiferous iron ore from Wisconsin, containing approximately 5 per cent of manganese, not included in totals for the United States.

[2] Jenison, H. A. C., U. S. Geol. Survey Mineral Resources, 1919, pt. 1, pp. 93-148, 1921.

Manganese and manganiferous ore shipped from mines in the United States in 1920, by States.

State.	Ore containing 35 per cent of manganese or more.			Ore containing 10 to 35 per cent of manganese.			Ore containing 5 to 10 per cent of manganese.		
	Number of shippers.	Quantity (gross tons).	Value.	Number of shippers.	Quantity (gross tons).	Value.	Number of shippers.	Quantity (gross tons).	Value.
Alabama	3	57	$1,923	1	150	(a)	.....	.....	.....
Arizona:									
Used for fluxing	.....	.....	.....	1	345	(a)	.....	.....	.....
Used for other purposes	3	2,402	72,067	.....	.....	.....	.....	.....	.....
Arkansas	14	3,445	93,077	9	4,403	$38,919	1	147	$308
California	5	1,733	53,285	.....	.....	.....	.....	.....	.....
Colorado:									
Used for fluxing	.....	.....	.....	b 12	28,483	42,725	5	c 6,187	9,281
Used for other purposes	3	3,643	52,545	b 3	11,056	100,808	.....	.....	.....
Georgia	1	341	9,512	2	4,989	(a)	1	1,086	(a)
Michigan	.....	.....	.....	1	23,832	(a)	1	29,541	(a)
Minnesota	.....	.....	.....	10	293,524	1,084,553	3	248,913	527,393
Montana	5	76,441	1,966,881	.....	.....	.....	.....	.....	.....
Nevada:									
Used for fluxing	.....	.....	.....	2	95,142	286,440	.....	.....	.....
Used for other purposes	5	1,240	21,673	.....	.....	.....	.....	.....	.....
New Mexico:									
Used for fluxing	.....	.....	.....	.....	.....	.....	1	541	(a)
Used for other purposes	6	2,053	32,107	4	19,259	97,531	.....	.....	.....
Tennessee	3	502	16,436	.....	.....	.....	.....	.....	.....
Utah	.....	.....	.....	1	66	(a)	.....	.....	.....
Virginia	7	2,523	73,929	.....	.....	.....	.....	.....	.....
Wisconsin	.....	.....	.....	.....	.....	.....	d 1	d 253,046	(a d)
Wyoming	1	40	2,800	.....	.....	.....	.....	.....	.....
Undistributed	.....	.....	.....	.....	.....	132,157	.....	.....	1,043,072
	56	94,420	2,396,235	b 45	481,249	1,783,133	d 12	cd286,415	d 654,665

a Included under "Undistributed." Geological Survey not at liberty to publish.
b One shipper of flux in Colorado also shipped ores for other purposes in Colorado. This shipper is not duplicated in the total for the United States.
c Includes 1,250 gross tons of ore containing less than 5 per cent of manganese.
d Manganiferous iron ore from Wisconsin, containing approximately 5 per cent of manganese, not included in totals for United States.

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Manganese ore containing 35 per cent or more of manganese shipped from mines in the United States, 1915–1920, by States.

State.	1915			1916			1917			1918			1919			1920		
	Number of shippers.	Quantity (gross tons).	Value.	Number of shippers.	Quantity (gross tons).	Value.	Number of shippers.	Quantity (gross tons).	Value.	Number of shippers.	Quantity (gross tons).	Value.	Number of shippers.	Quantity (gross tons).	Value.	Number of shippers.	Quantity (gross tons).	Value.
Alabama	1	200	(a)	1	(a)	(a)	3	264	$10,538	1	709	(a)	1	40	(a)	3	57	$1,923
Arizona:																		
Used for fluxing													1	18	(a)			
Used for other purposes	1	339	(a)	5	3,060	$113,060	22	14,802	479,971	35	17,612	$570,005	4	529	$14,445	3	2,402	72,067
Arkansas	7	1,288	$13,135	10	6,318	180,722	13	10,140	448,511	21	7,731	354,235	5	2,558	60,633	14	3,445	93,077
California	6	2,563	29,004	6	6,136	122,592	40	14,196	328,501	47	24,067	740,566	9	11,289	329,200	5	1,733	53,285
Colorado:																		
Used for fluxing							1	54	(a)									
Used for other purposes	1	150	(a)	3	110	1,670	1	60	(a)	4	4,821	180,246	3	11,166	238,671	3	3,643	52,545
Georgia	4	3,168	33,927	1	(a)	(a)	13	3,614	89,888	12	6,679	284,615	1	48	(a)	1	341	9,512
Montana				6	6,418	37,978	28	61,109	1,797,842	37	199,932	4,623,378	6	24,993	993,633	5	76,441	1,966,881
Nevada:																		
Used for fluxing													1	347	(a)			
Used for other purposes				2	(a)	(a)	6	3,450	91,907	17	19,872	544,727	1	78	(a)	5	1,240	21,673
New Jersey										1	64	(a)						
New Mexico				1	(a)	(a)	6	2,603	54,143	12	3,126	80,195				6	2,053	32,107
North Carolina							2	102	(a)	1	315	(a)						
Oregon										1	198	(a)						
South Carolina							1	405	(a)	1	100	(a)						
South Dakota										1	31	(a)						
Tennessee	1	150	(a)	3	429	8,380	13	1,996	75,066	23	4,162	153,830	6	328	8,388	3	502	16,436
Texas	1	(a)	(a)	1	(a)	(a)	1	25	(a)	1	380	(a)						
Utah:																		
Used for fluxing	1	55	(a)															
Used for other purposes	1	(a)	(a)	6	1,282	22,597	6	4,195	118,927	10	5,100	140,038						
Virginia	7	1,620	17,988	15	4,417	118,342	18	12,360	588,806	21	10,928	500,528	6	3,928	142,431	7	2,523	73,929
Washington				1	(a)	(a)												
Wyoming							1	30	(a)	1	42	(a)				1	40	2,800
Undistributed		80	19,057		3,304	50,937			25,622			68,023			9,462			
	31	9,613	113,111	61	31,474	656,278	175	129,405	4,109,722	247	305,869	8,240,386	44	55,322	1,796,863	56	94,420	2,396,235

a Included under "Undistributed." Geological Survey not at liberty to publish.

Manganese and manganiferous ore shipped from mines in the United States, 1911–1920, in gross tons.

Year.	Ore containing 35 per cent of manganese or more.	Ore containing 10 to 35 per cent of manganese.	Ore containing 5 to 10 per cent of manganese.
1911	2,457	37,584	6,853
1912	1,664	40,863	10,654
1913	4,048	51,512	7,891
1914	2,635	91,666	6,599
1915	9,613	180,953	[a] 14,782
1916	31,474	453,853	[b] 90,473
1917	129,405	730,759	[c] 130,185
1918	305,869	916,163	[d] 254,299
1919	55,322	309,834	[e] 123,899
1920	94,420	481,249	[f] 286,415

[a] Includes 796 tons of ore containing less than 5 per cent of manganese.
[b] Includes 1,026 tons of ore containing less than 5 per cent of manganese.
[c] Includes 141 tons of ore containing less than 5 per cent of manganese.
[d] Includes 1,684 tons of ore containing less than 5 per cent of manganese.
[e] Includes 844 tons of ore containing less than 5 per cent of manganese.
[f] Includes 1,250 tons of ore containing less than 5 per cent of manganese.

MANGANESE ORE.

SHIPMENTS.

The shipments of manganese ore during 1920 were 94,420 gross tons, valued at $2,396,235—an increase of 71 per cent in quantity and of only 33 per cent in value. The reason that the quantity of manganese ore shipped increased so much in proportion to the value is partly because some operators desired to dispose of their product at whatever price was obtainable and partly because some found it possible to produce manganese more cheaply than before. In 1920 there were 56 shippers of ore containing 35 per cent or more of manganese, compared with 44 in 1919 and 247 in 1918; 45 shippers of ore containing 10 to 35 per cent of manganese, compared with 41 in 1919 and 126 in 1918; and 12 shippers of ore containing 5 to 10 per cent of manganese, compared with 19 in 1919 and 35 in 1918.

IMPORTS.

The following table was compiled from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce:

Manganese ore imported into the United States, 1917–1920.

Country.	1917		1918		1919		1920	
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.
Africa	4	$180	95	$2,128	1,338	$19,157	31,927	$123,415
Argentina	[a] 6,600	40,023	[a] 849	39,127	[a] 2,305	86,547	[a] 5,500	275,000
Australia			198	13,990	548	26,365		
Brazil	512,517	8,578,296	345,877	10,174,138	246,592	7,177,071	421,523	8,833,493
Canada	883	40,534	301	11,968	582	16,926	828	28,509
Chile	202	6,330	2,998	48,760	441	13,950	12,563	312,794
China	20	438	3,000	146,909	1	30	3,383	126,648
Colombia					10	969		
Costa Rica	7,163	211,601	9,680	290,853	9,988	351,237	2,413	60,325
Cuba	44,511	612,413	82,974	2,751,193	35,320	1,433,202	8,247	266,744
Czecho-Slovakia							1,874	58,602
Ecuador			107	3,422	20	641		
France							188	48,076
Germany							11	3,209
Hongkong					1,265	27,940	9,520	207,441
India (British)	48,975	362,582	29,275	547,886	9,200	254,971	71,238	551,660
Japan	2,745	85,538	709	30,337	651	39,039	474	36,762
Mexico	345	9,790	5,251	159,357	6,295	266,307	2,925	55,449
Oceania (French)							7,510	75,316
Panama	5,202	163,120	5,607	262,520	2	76		
Peru			20	641				
Portugal					400	31,100		
Russia					6,916	296,915	18,762	858,804
Turkey					2,000	120,000	1,000	65,000
United Kingdom	805	152,084	4,362	612,638	9,470	1,066,741	7,049	243,564
Venezuela							2	111
	629,972	10,262,929	491,303	15,095,867	333,344	11,229,184	606,937	12,230,922

[a] Believed by the United States consul at Buenos Aires to be ore imported from Brazil and reexported to the United States.

PRODUCTION IN PRINCIPAL PRODUCING COUNTRIES.

Manganese ore produced in principal producing countries,[a] 1914–1920, in metric tons.

Country.	Percentage of manganese.	1914	1915	1916	1917	1918	1919	1920
North America:								
Canada		25	182	868	143	399	600	[b] 841
Costa Rica	37–48	.....	.....	[b] 1,263	[b] 7,278	[b] 9,835	[b] 10,148	[b] 2,452
Cuba	36–44	.....	[b] 5,223	[b] 31,054	[b] 45,225	[b] 84,306	[b] 35,887	[b] 8,379
Mexico	40+	.....	.....	.....	73	2,878	2,294	839
Panama	50±	.....	.....	[b] 10,666	[b] 5,285	[b] 5,696	[b] 2	.....
Porto Rico	35+	.....	.....	[c] 749	[c] 1,208	[c] 1,372	[d]	[d]
United States	35+	2,677	9,767	31,978	131,482	310,778	56,210	95,935
South America:								
Brazil	38–50	[c] 183,630	[c]288,671	[c]503,130	[c] 532,855	[c] 393,388	[c] 205,725	[c]453,737
Chile	40–48	.....	.....	.....	[b] 205	[b] 3,046	[b] 448	[b]12,765
Europe:								
Austria	.....	13,808	11,926	[d]	[d]	[d]	5,267	[d]
Belgium	.....	.....	500	3,870	2,040	2,610	.....	.....
Bosnia and Herzegovina	.....	[d]	10,422	22,674	48,851	[d]	[d]	[d]
France	30+	6,393	10,324	10,807	11,589	9,871	7,016	5,697
Germany	30+	165	548	[d]	[d]	[d]	[d]	[d]
Hungary	.....	14,413	[d]	[d]	90,269	[d]	[d]	[d]
Italy	18–45	1,649	12,577	18,147	24,532	31,896	30,841	29,140
Russia	41–48	[e] 715,057	[e] 8,844	[e] 8,862	[d e]	[d e]	[d]	[d]
Spain	29+	13,155	14,328	14,178	57,474	77,714	66,685	21,256
Sweden	.....	3,724	7,733	9,048	20,027	16,648	12,400	[d]
United Kingdom	30+	3,492	4,714	5,222	10,101	17,736	12,272	13,082
Africa:								
Gold Coast	.....	.....	.....	.....	[f]	30,777	35,754	44,310
Tunis	.....	.....	1,460	2,027	5,970	820	1,313	[d]
Asia:								
China	.....	.....	.....	.....	[b] 20	[b] 3,048	[b] 1	[b] 3,437
India	47–52	693,858	457,646	664,704	600,296	526,266	546,630	[d]
Japan	50+	17,067	25,871	49,310	51,374	[g] 29,759	[g] 22,877	[d]
Oceania:								
Australia	40+	26	556	1,292	290	9,034	5,049	[d]
Dutch East Indies	.....	.....	.....	.....	.....	1,450	2,915	4,179

[a] Figures are available for some years for Greece, New Caledonia, the Philippine Islands, and the Union of South Africa, but the production of none of these countries is sufficient to be included in this table.
[b] Imports into the United States. Production and exports not available.
[c] Exports.
[d] Not available.
[e] According to an article by D. Ghombashidze, F.R. G.S., delegate of the Georgian Government, in "The mineral resources of Georgia and Caucasia," manganese production in the Georgian Republic was 954,645 tons in 1913, 652,354 tons in 1914, 258,220 tons in 1915, 247,000 tons in 1916, 201,380 tons in 1917, and 150,000 tons in 1918.
[f] Shipments June, 1916, to November, 1917, 31,482 metric tons.
[g] Official figures covering all mines that produced over 375 metric tons. Unofficial figures for all mines were 59,000 metric tons for 1918 but are not yet available for 1919.

FERRUGINOUS MANGANESE ORE.

The shipments in 1920 of ores containing 10 to 35 per cent of manganese were 481,249 gross tons, valued at $1,783,133. The quantity was 55 per cent and the value 51 per cent higher than in 1919. The shipments of ferruginous manganese ore from the Cuyuna range were the highest recorded except those for 1917 and 1918. The shipments from Arkansas, Colorado, Georgia, Nevada, and New Mexico also increased somewhat. The increases in Colorado and Nevada were entirely in ores used for fluxing.

Ferruginous manganese and manganiferous iron ores shipped from the Cuyuna district, Minn., 1916-1920, in gross tons.

Mine.	Ore containing 10 to 35 per cent of manganese.					Ore containing 5 to 10 per cent of manganese.					Total, 1913-1920.
	1916	1917	1918	1919	1920	1916	1917	1918	1919	1920	
Algoma (Hoch)	23,000	[a]84,125	21,200	24,478	[b]5,115						[a]165,710
Arko			733	500	2,044						3,277
Cuyuna Mille Lacs	90,000	112,554	132,515					25,560			477,050
Ferro	14,710	(a)	57,261	14,556							[a]86,527
Gloria				2,637	738						3,375
Hillcrest						2,712	9,590	20,242			32,544
Hopkins			36,651	5,849							42,500
Ida Mae			5,134		[b]20,851						25,985
Joan, Nos. 1 and 4		8,375	27,931		8,500						44,806
Kennedy										9,511	9,511
Mahnomen	(c)	4,000	132,726	11,472	9,842	[c]43,000	82,000	175,648	90,896	81,066	630,650
Mangan, Nos. 1 and 2	30,329	52,290	67,796	92	10,979			4,679			166,165
Martin			349					1,073			1,422
Merritt, Nos. 1 and 2		33,180	78,555		33,239						144,974
Portsmouth										158,336	158,336
Sagamore				79,248	163,904				7,324		250,476
Sultana	35,218	65,018	64,158	120	[b]38,312						202,978
	193,257	359,542	625,009	138,952	293,524	45,712	91,590	227,202	98,220	248,913	2,446,286

[a] Shipments from Ferro mine included with Algoma mine for 1917. Not reported separately to the Geological Survey.
[b] According to the Iron Trade Review.
[c] Shipments from Mahnomen mine in 1916 averaged 5 to 14 per cent of manganese. Not reported in greater detail to the Geological Survey.

Manganiferous silver ore shipped, 1915–1920, in gross tons.

Year.	Arizona.	Colorado.		Nevada.	New Mexico.	Utah.
		For fluxing.	For other purposes.			
1915	[a] 1,452	14,965	15,956	104,498	.....	55
1916	[a] 7,392	16,263	90,600	122,429	.....	27
1917	[a] 32,009	20,546	104,169	122,872	.....	100
1918	[a] 10,854	24,931	99,110	80,096	475	.....
1919	[a] 1,964	29,769	11,055	77,815	250	.....
1920	345	34,670	11,056	95,142	541	.....

[a] Ore containing more than 35 per cent of manganese sent to makers of manganese alloys not included.

For a discussion of the value and uses of manganese ores the reader is referred to the report on manganese and manganiferous ores in 1919.

MANGANIFEROUS ZINC RESIDUUM.

Unique deposits of zinc ore containing franklinite, willemite, zincite, calcite, and minor silicate and other minerals occur near Franklin Furnace, N. J. By mechanical and electromagnetic processes of separation three products are obtained from these ores, one containing the greater part of the franklinite and the remaining two the other zinc minerals. The franklinite product is first roasted with anthracite to eliminate the zinc, which is recovered as zinc oxide, and the residue, containing 12 to 15 per cent of manganese and 40 per cent of iron, is smelted to spiegeleisen.

Manganiferous residuum produced from zinc roasting in the United States and shipped, 1911–1920, in gross tons.

1911	109,296	1916	198,817
1912	104,670	1917	155,332
1913	102,239	1918	146,796
1914	100,198	1919	80,418
1915	159,318	1920	133,602

FERROMANGANESE AND SPIEGELEISEN.

For a discussion of the manufacture, specifications, and uses of ferromanganese and spiegeleisen the reader is referred to the report on manganese and manganiferous ores in 1919.

The firms that make ferromanganese and spiegeleisen are listed below (f indicates ferromanganese; s, spiegeleisen):

fs..American Manganese Manufacturing Co., Dunbar, Pa.
f...Anaconda Copper Mining Co., Great Falls, Mont.
f...B. & B. Trading Co., Troy, N. Y.
fs..Bethlehem Steel Corporation, Lebanon, Pa.
f...Bilrowe Alloys Co., Tacoma, Wash.
fs..Cambria Steel Co., Widener Building, Philadelphia, Pa.
s...Colorado Fuel & Iron Co., Pueblo, Colo.
f...Donner Steel Co., North Tonawanda, N. Y.
f...Electro Metallurgical Co., Niagara Falls, N. Y.
f...Ferro Alloy Co., Utah Junction, Colo.
fs..J. B. Guernsey & Co., Graham, Va.
s...J. B. Guernsey & Co., Roanoke, Va.
fs..Juniata Furnace & Foundry Co., Newport, Pa.
fs..Lackawanna Steel Co., Buffalo, N. Y.
f...Lavino Furnace Co., Lebanon, Pa.
fs..Lavino Furnace Co., Marietta, Pa., and Reusens, Va.
s...Lavino Furnace Co., Sheridan, Pa.
fs..E. E. Marshall, Harrisburg, Pa.
fs..Midvale Steel & Ordnance Co., Johnstown, Pa.
f...National Alloy Co., Twenty-fifth and Dickinson streets, Philadelphia, Pa.
s...New Jersey Zinc Co., Palmerton, Pa.
f...Noble Electric Steel Co., Heroult, Calif.
f...Pacific Alloy & Steel Co., Bay Point, Calif.
f...Pittsburg Radium Co., Denver, Colo.
fs..Seaboard Steel & Manganese Corporation, Temple, Pa.
f...Seattle Smelting Co., Seattle, Wash.
fs..Southeastern Iron Corporation, Goshen, Va.
fs..Southern Manganese Corporation, Anniston, Ala.
f...Steel & Tube Co. of America, South Chicago, Ill.
fs..Tennessee Coal, Iron & Railroad Co., Bessemer and Birmingham, Ala.
f...Tennessee Manganese Co., Cleveland, Tenn.
fs..United States Ferro Alloy Co., Niagara Falls, N. Y.
fs..United States Steel Corporation, Chicago, Ill., and Pittsburgh, Pa.
f...Western Reduction Co., Portland, Oreg.

Ferromanganese and spiegeleisen shipped from furnaces in the United States, 1916–1920.

Year.	Ferromanganese.		Spiegeleisen.	
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.
1916	224,103	$30,123,493	182,837	$6,158,202
1917	260,225	53,930,771	189,241	9,756,236
1918	306,076	69,045,678	263,861	17,276,494
1919	198,255	27,093,816	90,855	3,965,754
1920	276,594	41,840,690	103,672	5,289,049

Ferromanganese and spiegeleisen imported for consumption in the United States, 1916–1920.

Year.	Ferromanganese.		Spiegeleisen.		Total.	
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.
1916	90,928	$9,240,528	.....	.....	90,928	$9,240,528
1917	41,969	5,710,988	3,968	$291,594	45,937	6,002,582
1918	27,168	4,258,745	1,969	228,012	29,137	4,486,757
1919	33,022	4,283,541	27	1,018	33,049	4,284,559
1920	59,254	7,775,278	5,234	277,900	64,488	8,053,178

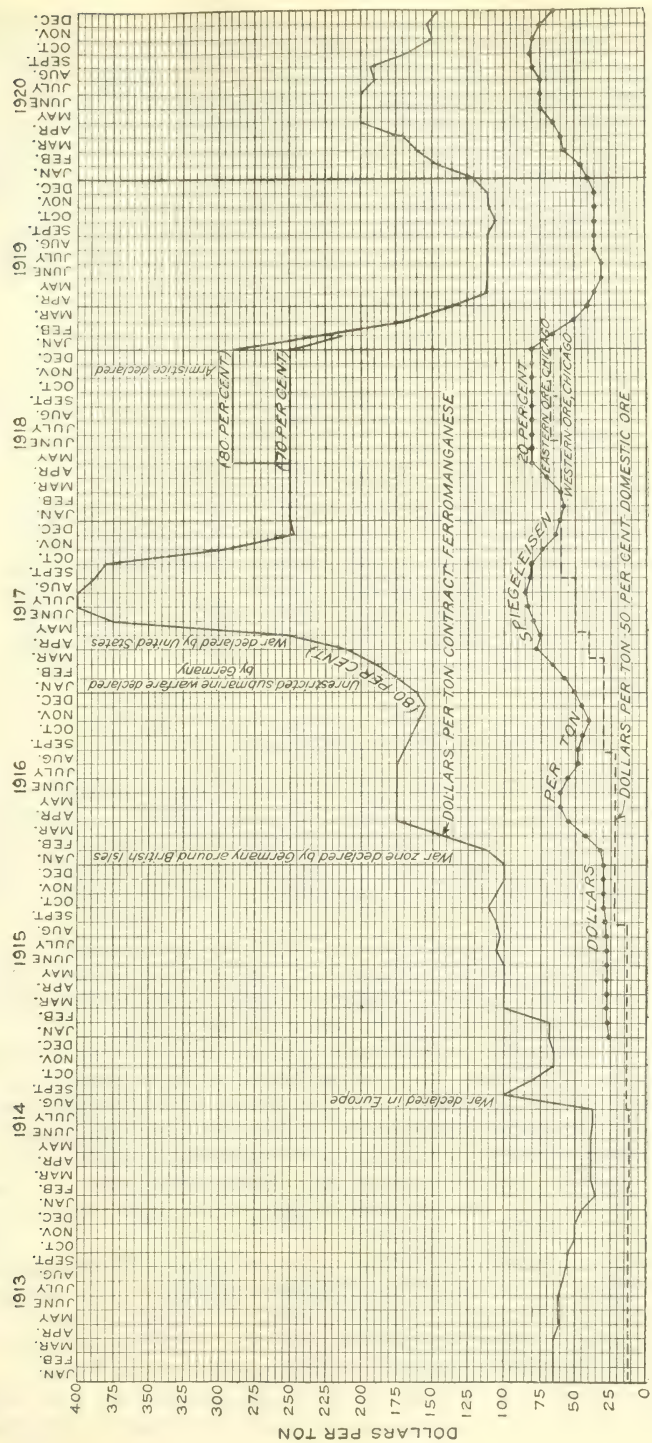

FIGURE 7.—Diagram showing contract prices of ferromanganese, spiegeleisen, and manganese ore, 1913 to 1920.

The following records of average contract prices of ferromanganese and of spiegeleisen by months for the last four years show a wide range. The ferromanganese prices are prices at eastern seaboard points, except those for January to August, inclusive, and November, 1920, which are on delivered basis; the prices of spiegeleisen are prices at furnaces. (See also fig. 7.) Prices on ferromanganese from May, 1918, to and including January, 1919, are based on 70 per cent of manganese, and other prices on 80 per cent; prices on spiegeleisen from April, 1918, to and including June, 1919, are based on 16 per cent of manganese and other prices on 20 per cent.

Prices per gross ton of ferromanganese and spiegeleisen, 1917–1920.[a]

Month.	Ferromanganese.				Spiegeleisen.			
	1917	1918	1919	1920	1917	1918	1919	1920
January	$175.00	$250.00	$212.50	$146.00	$57.50	$59.00	$67.50	$46.60
February	192.50	250.00	165.00	160.00	66.25	59.00	52.50	57.60
March	212.50	250.00	134.00	172.00	77.50	65.50	42.50	60.40
April	250.00	250.00	113.75	200.00	76.75	70.00	34.50	66.85
May	375.00	250.00	110.00	200.00	78.00	71.00	31.35	75.00
June	400.00	250.00	111.75	198.00	83.00	75.00	27.50	75.00
July	400.00	250.00	111.00	190.00	85.00	75.00	34.00	75.00
August	387.50	250.00	110.00	193.75	81.25	75.00	34.00	79.35
September	380.00	250.00	105.00	167.00	80.50	75.00	34.00	82.00
October	300.00	250.00	110.00	151.00	73.50	75.00	34.00	80.00
November	247.50	250.00	110.00	153.00	63.25	75.00	34.00	74.35
December	247.50	236.00	121.00	145.00	60.00	72.50	39.00	64.40

[a] Iron Trade Review.

OPERATIONS IN 1920, BY STATES.

Alabama.—Three operators in Alabama shipped manganese ore in 1920 from Cherokee, Cleburne, and Etowah counties. A deposit of manganiferous ore was discovered in the hills near Plantersville, Dallas County about 20 miles north of Selma, and about 5 carloads of ore were shipped to the Birmingham iron and steel mills from this property.

Arizona.—Only three operators shipped manganese ore from Arizona in 1920 compared with five in 1919. The shipments, however, increased from 547 to 2,402 gross tons. All the low-grade ore shipped was manganiferous silver ore used for fluxing.

Arkansas.—Arkansas experienced greater activity in manganese production in 1920 than any other State except Montana. This activity resulted in shipments of 3,445 gross tons of manganese ore and 4,550 tons of manganiferous ore, both of which, but particularly the latter, represent a large increase over the shipments in 1919. All the ore shipped in 1920 was from the Batesville-Cushman district. At the end of the year several new washing and concentrating plants were under construction.

California.—Shipments of manganese ore from California decreased from 11,289 gross tons in 1919 to 1,733 tons in 1920. The ore shipped in 1920 contained from 44 to 55 per cent of manganese and 3 to 18 per cent of silica. The Buckeye Mining Co., the largest shipper of manganese ore in California in 1919, shipped no ore in 1920.

Colorado.—Only 3,643 gross tons of manganese ore was shipped from Colorado in 1920, a decrease of 7,523 tons from the shipments

of 1919. Shipments of low-grade ore increased, however, owing to an increase in the demand for fluxing ore.

Georgia.—Manganese and manganiferous ores were shipped in 1920 by the Cherokee Mining Co. from Blue Ridge, Fannin County, Ga. The Republic Iron & Steel Co. shipped manganiferous ore to its own furnaces.

Michigan.—In 1920 manganiferous ore was shipped by the Oliver Iron Mining Co. for the first time from its Davis mine, at Ironwood, Gogebic County, Mich.

Minnesota.—The total shipments of manganiferous ore from the Cuyuna range, Minn., in 1920 amounted to 542,437 gross tons, the largest shipments recorded except those for 1918, and an increase of 305,265 tons over the shipments of 1919. The Gordon Mining Co. shipped manganiferous ore for the first time from its mine at Portsmouth and was the largest shipper of ore containing from 5 to 10 per cent of manganese. Low-grade ore was also shipped for the first time from the Kennedy property of the Rogers Brown Ore Corporation.

Montana.—The large increase in shipments of manganese ore from Montana—from 24,993 gross tons in 1919 to 76,441 tons in 1920—was entirely due to the output of the Emma mine of the Anaconda Copper Mining Co. at Butte. A large part of the 56,265 tons of manganese ore shipped by the Anaconda Copper Mining Co. was smelted into ferromanganese at its own plant at Great Falls, Mont.

Nevada.—Five producers of manganese ore in Nevada in 1920 shipped 1,240 gross tons, compared with two producers in 1919 who shipped 425 tons. Shipments of fluxing ore also increased from 77,815 tons in 1919 to 95,142 tons in 1920.

New Mexico.—There were six shippers of manganese ore in New Mexico in 1920, compared with none in 1919. The shipments were 2,053 gross tons, valued at $32,107. There was also an increase in shipments of low-grade ore during the year.

Tennessee.—The shipments of manganese ore by the three operators in Tennessee in 1920 came from Carter County. An increase of 174 gross tons was made over the shipments of high-grade ore in 1919.

Utah.—Sixty-six gross tons of manganiferous ore mined in 1918 was shipped from Utah in 1920 by the Needles Mining Co.

Virginia.—The shipments of manganese ore from Virginia decreased from 3,928 gross tons in 1919 to 2,523 tons in 1920. Shipments were made from Augusta, Frederick, Giles, Page, Shenandoah, and Smyth counties.

Wyoming.—Manganese ore was shipped from the Poverty mine, Marshall, Albany County, Wyo., in 1920 by Clifton Wissler.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH.[1]

(MINES REPORT.)

By V. C. Heikes.

PRODUCTION.

SUMMARY.

The output of ores of gold, silver, copper, lead, and zinc from mines in Utah in 1920 increased nearly 1 per cent in quantity, and the value of the metals recovered increased about 10 per cent over that for 1919. The greatest gain was in lead, which showed an increase of nearly 72 per cent in value. Silver increased more than 9 per cent, and zinc more than 100 per cent. The decrease in gold (7 per cent) was due largely to the smaller output of copper, the value of which decreased nearly 7 per cent.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1919–20.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	179	6,745,423	$2,159,471	11,649,961	124,061,807	123,829,051	4,431,024	$15,169,328
1920	164	6,800,180	[a] 2,014,556	[a] 13,106,976	116,931,238	140,838,113	8,157,739	49,744,334
Increase or decrease, 1920	−15	+54,757	−144,915	+1,457,015	−7,130,569	+17,009,062	+3,726,715	+4,575,006
1864–1920 [b]			100,242,530	404,233,061	2,430,325,088	4,407,275,545	222,945,789	1,097,116,596

[a] Includes small placer production.
[b] The total by years to the end of 1917 appears in U. S. Geol. Survey Prof. Paper 111, p. 127, 1920.

The dividends paid by 13 producers in 1920 amounted to $11,790,133, which gives a total paid to stockholders since mining became profitable of $221,759,266.

ORE.

The output of dry and siliceous ore increased 21 per cent. This classification includes 19 tons of dry or siliceous gold ores averaging $92.47 in gold and 7.16 ounces of silver per ton. Gold and silver mixed dry or siliceous ore was produced from only two properties. The siliceous silver ores mined in 1920 by 45 producers amounted to

[1] Valuable assistance in the preparation of the report and the compilation of statistical tables was rendered by B. N. Patchell, of the United States Geological Survey.

266,164 tons and averaged per ton $1.79 in gold, 13.99 ounces of silver, 7.91 pounds of copper, and 20.38 pounds of lead. The chloridizing roasting process was used only at Silver City, in the Tintic district, where 54,419 tons of siliceous silver ore and some sulphide ore were treated.

Concentrates of all kinds produced in Utah in 1920 aggregated 424,220 tons and contained nearly 48 per cent of the gold, against nearly 52 per cent in 1919; more than 16 per cent of the silver against more than 13 per cent in 1919; more than 88 per cent of the copper and zinc against the same percentage in 1919; and nearly 29 per cent of the lead, against nearly 30 per cent in 1919.

Crude ore of all kinds shipped directly to the smelters amounted to 611,346 tons, or about 9 per cent of the total output, and produced nearly 47 per cent of the gold in 1920, against nearly 44 per cent in 1919; about 79 per cent of the silver, against nearly 81 per cent; more than 9 per cent of the copper, against more than 11 per cent; more than 70 per cent of the lead, against more than 69 per cent; and nearly 12 per cent of the zinc, against nearly 11 per cent.

Ore and metals produced in Utah in 1920.

Source of production.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Placers	3		$453	7			
Dry or siliceous ore	50	291,020	689,364	3,955,771	2,116,803	6,282,276	
Copper ore	23	5,778,373	658,305	452,915	108,645,375	31,461	
Lead ore	109	559,896	375,937	7,895,007	4,961,482	111,133,846	
Zinc ore	4	2,162					924,214
Copper-lead ore	9	6,389	4,626	172,401	407,397	2,155,329	
Lead-zinc ore	10	162,340	285,871	630,875	800,181	21,235,201	7,233,525
		6,800,180	2,014,556	13,106,976	116,931,238	140,838,113	8,157,739

Ore sold or treated in Utah in 1920, in short tons.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	86	31	14,916		2		15,035
Box Elder	32,457	193	87	71			32,808
Iron	17						17
Juab	136,076	6,314	113,142	252	397	111	256,292
Morgan		15					15
Piute	24,964						24,964
Salt Lake	17,845	5,771,042	190,905		4,141	126,228	6,110,161
Summit	12,577		119,258				131,835
Tooele	39,344	612	58,347	1,839	1,849	3,835	105,826
Utah	26,963		54,064				81,027
Wasatch	691		9,177			32,166	42,034
Washington		166					166
	[a] 291,020	5,778,373	559,896	2,162	6,389	162,340	6,800,180
Value per ton in gold and silver	$17.18	$0.20	$16.04		$30.14	$6.00	$2.40

[a] Includes 19 tons of gold ore, 24,837 tons of gold and silver ore, and 266,164 tons of silver ore.

GOLD.

The mine production of gold decreased nearly 7 per cent. The demand of the smelters for dry and siliceous ore and lead-silver ore partly offset the decline in the gold from other sources. Most of the

gold came from ores mined at Bingham, in Salt Lake County; Juab and Piute counties were next in rank.

Most of the gold produced in Utah is a by-product of the copper and lead ores. The Utah Copper Co. was the largest producer of gold in 1920; the United States property at Bingham was second; and the Deer Trail, Highland Boy, Grand Central, and Chief Consolidated mines followed in order.

Mine production of gold in Utah in 1920, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	.....	7.45	3.00	700.56	0.10	.....	711.11
Box Elder	.....	1,022.99	.....	1.98	.....	.....	1,024.97
Iron	.....	2.66	.....	.....	.....	.....	2.66
Juab	.....	19,082.10	906.26	6,935.67	123.98	.....	27,048.01
Piute	.....	10,275.09	.....	.....	.....	.....	10,275.09
Salt Lake	5.95	1,696.37	30,936.25	5,485.77	78.66	13,458.94	51,661.94
San Juan	7.98	.....	.....	.....	.....	.....	7.98
Summit	.....	419.02	.....	2,901.93	.....	.....	3,320.95
Tooele	.....	71.98	.....	362.96	21.04	36.38	492.36
Uintah	7.98	.....	.....	.....	.....	.....	7.98
Utah	.....	684.36	.....	1,479.02	.....	.....	2,163.38
Wasatch	.....	85.97	.....	318.06	.....	333.69	737.72
	21.91	[a] 33,347.99	31,845.51	18,185.95	223.78	13,829.01	97,454.15

[a] Includes 85.00 ounces from gold ore, 10,209.30 ounces from gold and silver ore, and 23,053.69 ounces from silver ore.

SILVER.

The output of silver increased more than 12 per cent. The largest output was from Juab County, followed by Utah, Summit, and Salt Lake counties.

Only one operator reported cyanidation of gold and silver ores, and one small lot of ore was treated by amalgamation in 1920. At Silver City a leaching mill using a chloridizing roast on custom ores recovers a rich silver bullion from which 436,346 ounces was reported in 1920.

Seven properties each produced more than 500,000 ounces of silver in 1920. The Chief Consolidated, in the Tintic district, ranked first, with an output of 2,622,132 ounces followed by the Tintic Standard, in the same district, the Ontario and the Silver King Coalition, at Park City; the Eagle & Blue Bell, in the Tintic district; the Vipont Silver, in Box Elder County; and the Daly West, at Park City.

Mine production of silver in Utah in 1920, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	.....	2,187	319	185,541	581	.....	188,628
Box Elder	.....	524,473	.....	1,380	.....	.....	525,853
Iron	.....	589	.....	.....	.....	.....	589
Juab	.....	1,886,243	70,654	2,683,558	9,818	.....	4,650,273
Morgan	.....	.....	130	.....	.....	.....	130
Piute	.....	234,818	.....	.....	.....	.....	234,818
Salt Lake	3	131,920	375,764	1,036,044	131,135	378,506	2,053,372
San Juan	2	.....	.....	.....	.....	.....	2
Summit	.....	394,247	.....	1,768,294	.....	.....	2,162,541
Tooele	.....	84,684	5,982	357,272	30,867	19,588	498,393
Uintah	2	.....	.....	.....	.....	.....	2
Utah	.....	673,195	.....	1,609,266	.....	.....	2,282,461
Wasatch	.....	23,415	.....	253,652	.....	232,781	509,848
Washington	.....	.....	66	.....	.....	.....	66
	7	[a] 3,955,771	452,915	7,895,007	172,401	630,875	13,106,976

[a] Includes 136 ounces from gold ore, 233,146 ounces from gold and silver ore, and 3,722,489 ounces from silver ore.

COPPER.

The Bingham or West Mountain district, in Salt Lake County, produced the largest quantity of copper in 1920, followed by the Tintic district, in Juab County, and the Park City region, in Summit and Wasatch counties.

Copper concentrates produced at milling plants contained 102,001,563 pounds; lead concentrates, 1,453,267 pounds; and zinc concentrates, 75,840 pounds. Crude ore shipped to smelters contained 11,228,742 pounds of copper, against 13,998,982 pounds in 1919. The crude copper ore smelted contained 4,632,793 pounds, of which 3,642,597 pounds was from sulphide ores and 990,196 pounds from oxidized ores. Lead ores smelted produced 4,242,101 pounds of copper, the sulphide ores yielding 3,446,365 pounds and the oxidized ores 795,736 pounds. Copper-lead ores, which were mostly oxidized, contained 407,397 pounds of copper. The dry or siliceous ores, used principally for fluxing at smelting plants, contained 1,946,451 pounds, against 2,395,973 pounds in 1919. The low-grade copper-bearing disseminated ores mined and concentrated contained 104,005,479 pounds of copper, against 108,382,949 pounds in 1919.

The leading producers of copper, named in order of production, were the Utah Copper Co., reporting [2] 101,897,758 net pounds; the Highland Boy, 3,187,492 net pounds;[3] and the Ophir Hill mine.

Mine production of copper in Utah in 1920, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	1,229	8,108	37,951	126	.....	47,414
Box Elder	.....	43,468	.....	.....	.....	43,468
Juab	1,207,680	742,142	234,220	40,032	.....	2,224,074
Morgan	.....	2,994	.....	.....	.....	2,994
Piute	12,283	.....	.....	.....	.....	12,283
Salt Lake	563,234	107,703,035	2,243,940	255,521	595,250	111,360,980
Summit	42,579	.....	750,696	.....	.....	793,275
Tooele	81,962	46,028	924,769	111,718	39,200	1,203,677
Utah	204,101	.....	575,875	.....	.....	779,976
Wasatch	3,735	.....	194,031	.....	165,731	363,497
Washington	.....	99,600	.....	.....	.....	99,600
	[a] 2,116,803	108,645,375	4,961,482	407,397	800,181	116,931,238

[a] Includes 10,776 pounds from gold and silver ore and 2,106,027 pounds from silver ore.

LEAD.

The output of lead increased more than 13 per cent on account of the higher price and the better market for the metal.

The Bingham or West Mountain district produced 52,488,597 pounds, compared with 54,610,987 pounds in 1919. The greatest part of the production at Bingham came from the Utah Apex, United States, and Highland Boy mines. The Park City region produced 25,732,104 pounds, against 21,311,284 pounds in 1919; the Tintic district produced 41,240,223 pounds, against 24,463,163 pounds; the combined production of the Ophir and Rush Valley districts, in Tooele County, decreased from 11,063,952 pounds in 1919 to 9,190,635 pounds; and the output in Beaver County decreased from 4,897,083 pounds to 2,808,314 pounds.

[2] Utah Copper Co. Sixteenth Ann. Rept., for year ending Dec. 31, 1920.
[3] Utah Consolidated Mining Co. Ann. Rept. for year ending Dec. 31, 1920.

Ranking first in the output of lead was the property of the Utah Apex Mining Co., at Bingham, followed in order by the Chief Consolidated and Tintic Standard, in the Tintic district, the United States and Highland Boy, at Bingham, and the Silver King Coalition, at Park City. Each of these was credited with producing more than 10,000,000 pounds of lead. Those following were the Judge, Ophir Hill Consolidated, Eagle & Blue Bell, and Daly West mines.

Mine production of lead in Utah in 1920, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver	2,459	.....	2,805,567	288	.....	2,808,314
Box Elder	.....	.....	18,130	.....	.....	18,130
Juab	2,752,949	27,164	25,014,668	83,979	23,593	27,902,353
Piute	859,753	.....	.....	.....	.....	859,753
Salt Lake	348,986	4,297	41,754,643	1,258,667	15,795,463	59,162,056
Summit	483,654	.....	17,736,896	.....	.....	18,220,550
Tooele	952,270	.....	8,098,193	812,395	409,401	10,272,259
Utah	858,702	.....	13,224,442	.....	.....	14,083,144
Wasatch	23,503	.....	2,481,307	.....	5,006,744	7,511,554
	[a] 6,282,276	31,461	111,133,846	2,155,329	21,235,201	140,838,113

[a] Includes 858,249 pounds from gold and silver ore and 5,424,027 pounds from silver ore.

ZINC.

The output of zinc was nearly double that of 1919. The Park City, Bingham, and Smelter districts, and Tooele County, named in order of output, were the chief sources of zinc in 1920. Smaller quantities were produced in Juab County and in the Lucin district of Box Elder County. The total mine production of recoverable zinc in Utah was valued at $660,777, against $323,465 in 1919. Salt Lake County, with Bingham as the principal source, produced 3,702,361 pounds of recoverable zinc, against 2,579,608 pounds in 1919. At Midvale the old tailing dumps yielded 1,588,620 pounds of zinc.

The leaders in the output of zinc were the Judge property, near Park City, and the properties of the United States Mining Co., at Bingham, followed by the lessee working old tailing near Midvale. The Scranton mine, in Tooele County, was also a large producer.

There are in Nevada and Utah a number of mines that have been unable to profit from considerable deposits of medium-grade lead-free zinc ore because of their distance from the nearest market. To utilize this ore the Utah Zinc Co. recently completed a custom plant at Murray, Utah, for the manufacture of zinc oxide. The plant has no roasters and is not prepared to receive raw sulphide ores, although by-products from other plants where the roasting has been done are acceptable. The zinc in the ore may be in the form of carbonate, silicate, or oxide, but it should not contain more than approximately 1 per cent of lead. It is expected to operate the plant some time in 1921. A recent article [4] containing illustrations and flow sheet gives a full description of the works.

[4] Min. and Sci. Press, vol. 121, p. 759, Nov. 27, 1920.

Mine production of recoverable zinc in Utah in 1920, in pounds.

County.	Zinc ore.	Lead-zinc ore.	Total.
Box Elder	24,140	.....	24,140
Juab	145,019	35,925	180,944
Salt Lake	.....	3,702,361	3,702,361
Tooele	755,055	52,794	807,849
Wasatch	.....	3,442,445	3,442,445
	924,214	7,233,525	8,157,739

Zinc ore and concentrates produced from Utah mines and mills sold in 1920.

Classification.	County.	Quantity, dry weight.	Average assay of ore or concentrates.
		Short tons.	*Per cent.*
Sulphide zinc ore	Juab	252	33.85
Sulphide lead-zinc ore	....do	111	19.04
Mixed carbonate and siliceous ore	Box Elder and Tooele	1,910	24.00
Concentrates	Salt Lake, Tooele, and Wasatch	9,492	43.98
		11,765	40.29

UTAH MINING INDUSTRY, 1920.

Reduction of operations in the copper districts tended to relieve the scarcity of men in the silver-lead camps, and with the increase in the supply of labor there was a decided increase in efficiency. During the first four months of 1920 the high price for lead and an abundance of labor stimulated production. The next six months were marked by declining metal prices and demand and an extreme shortage of labor at both mines and smelters, which necessitated a curtailment of output. Improvement of conditions in November again permitted an increase in the lead output.

Underground mines at Bingham increased wages 25 cents a shift on April 1, but later notices were posted that wages would be reduced January 1, 1921. This applied particularly to the copper mines, which were operated on an average at less than 50 per cent of capacity throughout the year. With the decline in the market the largest producer, the Utah Copper Co., reduced its output of copper toward the end of the year to 7,500,000 pounds a month. Following the trend of commodity prices, the wage rate for miners was reduced to the scale prevailing prior to July, 1917.

All the smelters except one operated at reduced capacity toward the end of 1920. The lead smelter at Murray had five, six, and seven of the eight lead furnaces in blast, three on lead ores, three on siliceous ores, and one on low-grade iron arsenate ores.

The copper plant at Garfield operated three reverberatories at 40 per cent capacity on copper ores and concentrates from the Utah Copper mills.

At Tooele the International copper smelter was closed the middle of November and a set of its roasting furnaces was put into shape to make white arsenic. The lead furnaces of the International plant were operated either three or four at a time. The Midvale smelter of the United States Co. had four out of six of its lead furnaces working, and the arsenic plant was making a varied output of arsenic products.

METALLURGIC INDUSTRY.

Mine production of metals from Utah concentrates in 1920.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beaver	4,203	768	21.62	14,158	123	248,415	.....	$35,774
Box Elder	32,457	1,910	1,022.97	524,473	.....	.....	.....	592,823
Juab	16,596	3,885	278.00	231,692	19,065	1,717,356	.....	399,187
Piute	.....	1,436	3,140.20	71,278	10,232	747,763	.....	204,311
Salt Lake	5,728,723	378,702	41,326.68	777,432	102,833,418	25,367,991	3,702,361	22,952,378
Summit	36,951	8,007	385.37	156,484	37,553	3,575,456	.....	471,481
Tooele	43,797	16,054	109.94	179,778	464,548	3,866,033	52,794	597,268
Utah	772	193	18.82	2,964	.....	83,864	.....	10,329
Wasatch	32,166	13,265	333.66	232,781	165,731	5,006,744	3,442,445	970,500
	5,895,665	424,220	46,637.26	2,191,040	103,530,670	40,613,622	7,197,600	26,234,051

By kinds of concentrates.

Siliceous		1,910	1,022.97	524,473	.....	.....	.....	$592,823
Copper		318,057	27,410.86	271,823	102,001,563	.....	.....	19,631,208
Lead		94,761	18,038.08	1,337,381	1,453,267	40,171,418	.....	5,311,740
Zinc		9,492	165.35	57,363	75,840	442,204	7,197,600	698,280

Average content.

Kind of concentrates.	Quantity.	Gold	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	1,910	0.54	274.59	.....	.....	.....	$310.38
Copper	318,057	.09	.85	16.04	.....	.....	61.72
Lead	94,761	.19	14.11	.77	21.20	.....	56.05
Zinc	9,492	.02	6.04	.40	2.33	37.91	73.57
	424,220	.11	5.16	12.20	4.78	.85	61.84

Mine production of metals from Utah crude ore shipped to smelters in 1920.

By counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beaver	8,017	581.61	156,774	47,089	2,124,325	.....	$361,516
Box Elder	351	2.01	1,380	43,468	18,130	24,140	12,948
Iron	17	2.63	589	.....	.....	.....	697
Juab	190,118	26,057.40	4,014,788	2,044,889	26,184,997	180,944	7,400,490
Morgan	15	.....	130	2,994	.....	.....	693
Piute	1,278	2,907.63	40,745	2,051	111,990	.....	113,854
Salt Lake	206,899	10,313.95	1,275,441	6,516,058	33,788,417	.....	5,505,468
Summit	57,174	2,935.57	2,006,057	755,722	14,645,094	.....	3,557,946
Tooele	62,029	382.42	318,615	739,129	6,406,226	755,055	1,064,852
Utah	75,414	2,039.18	2,246,964	779,976	13,999,280	.....	3,754,804
Wasatch	9,868	404.03	277,067	197,766	2,504,810	.....	547,128
Washington	166	.....	66	99,600	.....	.....	18,398
	611,346	45,626.43	10,338,616	11,228,742	99,783,269	960,139	22,338,794

Mine production of metals from Utah crude ore shipped to smelters in 1920—Continued.

By kinds of ore.

Kind of ore.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Dry or siliceous	180,448	24,133.12	2,800,897	1,946,451	5,534,513	.....	$4,352,762
Copper	71,556	4,419.40	180,728	4,632,793	31,101	.....	1,143,272
Lead	350,680	16,850.12	7,184,590	4,242,101	92,038,733	.....	16,323,172
Zinc	2,162	.....	.....	.....	.....	924,214	74,861
Copper-lead	6,389	223.79	172,401	407,397	2,155,329	.....	439,930
Lead-zinc	111	.....	.....	.....	23,593	35,925	4,797

Average content.

Kind of ore.	Quantity.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounce per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	180,448	0.13	15.52	0.54	1.53	.....	$24.12
Copper:							
Oxidized	7,728	.43	10.50	6.41	.20	.....	37.95
Sulphide	63,828	.05	1.56	2.85	.....	.....	13.32
Lead:							
Oxidized	97,708	.06	23.68	.41	12.54	.....	48.72
Sulphide	252,972	.04	19.25	.68	13.29	.....	45.71
Zinc:							
Oxidized	1,910	.....	.....	.....	.....	20.40	33.04
Sulphide	252	.....	.....	.....	.....	28.77	46.61
Copper-lead:							
Oxidized	5,819	.03	26.45	3.19	17.38	.....	68.87
Sulphide	570	.11	32.39	3.43	11.63	.....	68.75
Lead-zinc:							
Sulphide	111	.....	.....	.....	10.63	16.18	43.22
	611,346	.07	16.91	.92	8.16	.08	36.54

PRODUCTION BY COUNTIES.

GENERAL FEATURES.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1920.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total value.		
	Quantity.	Value.	Quantity.	Value.		Quantity.	Value.
	Fine ounces.		*Fine ounces.*			*Fine ounces.*	
Beaver	.....	.....	711.11	$14,700	$14,700	188,628	$205,605
Box Elder	.....	.....	1,024.97	21,188	21,188	525,853	573,180
Iron	.....	.....	2.66	55	55	589	642
Juab	.....	.....	27,048.01	559,132	559,132	4,650,273	5,068,798
Morgan	.....	.....	.....	.....	.....	130	142
Piute	.....	.....	10,275.09	212,405	212,405	234,818	255,952
Salt Lake	5.95	$123	51,655.99	1,067,824	1,067,947	2,053,372	2,238,175
San Juan	7.98	165	.....	.....	165	2	2
Summit	.....	.....	3,320.95	68,650	68,650	2,162,541	2,357,170
Tooele	.....	.....	492.36	10,178	10,178	498,393	543,248
Uintah	7.98	165	.....	.....	165	2	2
Utah	.....	.....	2,163.38	44,721	44,721	2,282,461	2,487,882
Wasatch	.....	.....	737.72	15,250	15,250	509,848	555,734
Washington	.....	.....	.....	.....	.....	66	72
	21.91	453	97,432.24	2,014,103	2,014,556	13,106,976	14,286,604

Mine production of gold, silver, copper, lead, and zinc in Utah in 1920—Continued.

County.	Copper.		Lead.		Recoverable zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Beaver	47,414	$8,724	2,808,314	$224,665			$453,694
Box Elder	43,468	7,998	18,130	1,450	24,140	$1,955	605,771
Iron							697
Juab	2,224,074	409,230	27,902,353	2,232,188	180,944	14,657	8,284,005
Morgan	2,994	551					693
Piute	12,283	2,260	859,753	68,780			539,397
Salt Lake	111,360,980	20,490,420	59,162,056	4,732,965	3,702,361	299,891	28,829,398
San Juan							167
Summit	793,275	145,963	18,220,550	1,457,644			4,029,427
Tooele	1,203,677	221,477	10,272,259	821,781	807,849	65,436	1,662,120
Uintah							167
Utah	779,976	143,516	14,083,144	1,126,652			3,802,771
Wasatch	363,497	66,883	7,511,554	600,924	3,442,445	278,838	1,517,629
Washington	99,600	18,326					18,398
	116,931,238	21,515,348	140,838,113	11,267,049	8,157,739	660,777	49,744,334

Ore sold or treated, number of deep mines producing, and value of ores in Utah in 1919 and 1920.

County.	Ore sold or treated.		Number of deep mines producing.		Average total value per ton.		Average value per ton in gold and silver.	
	1920	Increase or decrease.	1919	1920	1919	1920[a]	1919	1920[a]
	Short tons.	*Short tons.*						
Beaver	15,035	−67,080	20	16	$8.74	$30.17	$4.32	$14.65
Box Elder	32,808	+30,799	5	3	33.67	18.46	6.11	18.12
Iron	17	+ 17		1		41.00		41.00
Juab	256,292	+23,085	38	31	31.40	32.32	25.28	21.96
Millard		− 4	1		11.50		11.50	
Morgan	15	− 44	1	1	25.83	46.20	4.24	9.47
Piute	24,964	+ 8,455	6	5	17.01	21.61	15.35	18.76
Salt Lake	6,110,161	− 1,611	52	52	4.71	4.72	.58	.54
Summit	131,835	+31,476	9	11	26.18	30.56	17.71	18.40
Tooele	105,826	+18,487	30	27	17.88	15.71	6.85	5.23
Utah	81,027	+16,746	13	10	43.19	46.93	35.38	31.26
Wasatch	42,034	− 5,457	2	3	20.75	36.10	9.92	13.58
Washington	106	− 112	2	1	93.10	110.83	.92	.43
	6,800,180	+54,757	179	161	6.70	7.31	2.25	2.40

[a] Value per ton, placer product excluded.

BEAVER COUNTY.

Mine production in Beaver County, Utah, 1919-20.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	20	82,115	$29,917	290,109	538,585	4,897,083	44,268	$717,793
1920	16	15,035	14,700	188,628	47,414	2,808,314		453,694
Decrease, 1920	4	67,080	15,217	101,481	491,171	2,088,769	44,268	264,099
Total, 1860–1920			851,491	21,989,958	52,859,946	425,615,779	36,070,774	52,295,632

Pine Grove district.—From the Revenue mine a small lot of silver ore, containing a little lead, was shipped in 1920.

Rocky district.—Considerable iron ore, containing a little silver and copper paid for at a flat rate by the smelter, was shipped from the Montreal property to the lead smelter at Murray for flux.

San Francisco district (Frisco and Newhouse).—Five producers in the San Francisco district reported the output of 13,807 tons of ore, containing $13,349 in gold, 171,575 ounces of silver, 29,651 pounds of copper, and 2,316,236 pounds of lead, valued in all at $391,121, or $28.33 a ton. The greater part of the ore, 6,799 tons, was of shipping grade, and most of it, containing lead and silver, was from the Horn Silver property. Much ore mined from the Carbonate & Rattler mine was milled in the flotation plant on the property and produced concentrate, containing lead and silver.

North and South Star districts.—Nine producers in the Star districts reported 1,176 tons of ore, containing $1,208 in gold, 15,748 ounces of silver, 17,678 pounds of copper, and 490,965 pounds of lead, valued in all at $60,904, or an average of $51.79 a ton. The principal properties producing were the Harrington-Hickory and Wild Bill. Ore was also shipped from the Gold Crown, Moscow, Lady Bryan, St. Croix, and Monitor properties.

BOX ELDER COUNTY.

Ashbrook district (Vipont).—Important development work and the completion of the flotation mill at the Vipont Silver property resulted in the shipment of considerable silver concentrate. Oakley, Idaho, 20 miles north of Vipont, on a branch of the Oregon Short Line Railroad, is the loading station for ore.

Lucin district.—Some low-grade oxidized zinc ore was shipped from the Tecoma property to the Utah Zinc Co. Lessees produced some ore, containing copper, lead, and silver, from the Copper Mountain property, and considerable iron ore was shipped as flux to the Salt Lake smelters.

JUAB COUNTY.

The quantity of ore mined and the quantity and value of all metals except silver and copper increased in Juab County. The output was mainly from the Tintic district.

Fish Springs district.—Old dump material from the Utah mine was concentrated in the small plant on the property and a rich silver-lead concentrate was smelted at Murray.

Tintic district.—All the mines of the Tintic district are reviewed under Juab County, although a number of important mines in the eastern part of the district are in Utah County.

Mine production in Tintic district, Utah, 1919–1920.

County.	Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
			Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Juab	1919	36	232,782	$495,015	4,788,095	2,560,513	17,471,370	93,571	$7,266,749
	1920	29	251,657	558,980	4,602,575	2,223,552	27,175,698	180,944	8,173,634
Utah	1919	8	64,150	40,519	1,991,734	690,495	6,991,793	.....	2,770,258
	1920	7	80,978	44,710	2,282,165	779,797	14,064,525	.....	3,800,915
Total	1919	44	296,932	535,534	6,779,829	3,251,008	24,463,163	93,571	10,037,007
	1920	36	332,635	603,690	6,884,740	3,003,349	41,240,223	180,944	11,974,549
Total, 1869–1920	.....	.....	.....	34,375,112	145,617,895	184,316,794	848,405,170	17,342,988	213,596,866
Total dividends, 1869–1920	.....	.....	.....	.....	.....	.....	.....	.....	36,378,675

The value of the metals for 1920 not shown in the above table is as follows: Gold, $603,690, against $535,534 in 1919; silver, $7,504,367, against $7,593,408; copper, $552,617, against $604,687; lead, $3,299,218, against $1,296,547; zinc, $14,657, against $6,831. The ore sold or treated in the district in 1920 averaged $36 a ton, compared with $33.80 in 1919.

Mine production in Tintic district, Utah, in 1920, by kinds of ore.

Kind of ore.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry or siliceous	25	163,039	19,766.47	2,559,438	1,411,781	3,611,651	.....
Copper	4	6,314	906.27	70,654	742,142	27,164	.....
Lead	26	162,522	8,406.77	4,244,830	809,394	37,493,836	.....
Zinc	1	252	.....	.....	.....	.....	145,019
Copper-lead	2	397	123.98	9,818	40,032	83,979	.....
Lead-zinc	1	111	.....	.....	.....	23,593	35,925
	.....	332,635	29,203.49	6,884,740	3,003,349	41,240,223	180,944

The Chief Consolidated Co.[4a] continued to lead in the production of silver and was the second largest producer of lead in the State. More ore was mined and shipped than in 1919, but development was curtailed. Mining was carried on 200 feet below water level by the completion of the No. 2 shaft, which was concreted to the depth of 1,910 feet. On the 1,880-foot level a drift will make connection with No. 1 shaft. Three mineral zones in the property are now being developed. According to the annual printed report of the company, the shipment of ore in 1920 aggregated 82,430 dry tons, yielding, after smelting, transportation, and sampling charges, $2,242,708.58. This represented the amount received from the smelting company, and after the deduction of other charges the net profit was $357,380.45. Dividends amounted to $353,692.80, which makes the total amount paid to

[4a] Chief Consolidated Mining Co. Twelfth Ann. Rept., for year ending Dec. 31, 1920.

stockholders since February, 1913, $1,871,517.67. The output of the mine in 1920 compared with that of 1919 follows:

Ore and metals produced by Chief Consolidated mine, 1919–20.

Year.	Ore.	Gold.	Silver.	Lead.	Copper.	Zinc.
	Dry tons.	*Ounces.*	*Ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
1919	63,726	3,753	2,757,533	5,979,588	15,574	.....
1920	82,430	4,461	2,622,132	12,717,410	3,814	212,906
1909–1920 [a]	535,977	54,528	14,991,908	75,540,830	386,197	2,401,279

[a] The production of the Chief Consolidated mine by years is given in Mineral Resources, 1918, pt. 1, p. 388.

Of the ore shipped, 45,326 tons was silver-lead ore with an average content of 0.0541 ounce of gold and 31.81 ounces of silver per ton, 14.03 per cent of lead (in lead ore), and 1.30 per cent of copper (in copper ore). The average total value of all ores was $47.29 a ton. Smelting, freight, and sampling cost $20.08 a ton, leaving a net average value of $27.21. The zinc in zinc ores averaged 33.86 per cent.

In the Plutus mine prospecting work through the 1,750-foot level of the Chief Consolidated property was continued with encouraging results.

The Centennial-Eureka mine continued as a small producer during the year, without interruption and without development of new ore bodies. Production amounted to 10,679 tons, compared with 21,288 tons in 1919. Work on the 1,800-foot level is prospecting two northeast and southwest fissures or breaks that have been productive in adjoining properties. Lessees worked in the upper levels of the mine.

At the Bullion-Beck mine, worked entirely by lessees, the output of silver-lead ore amounted to 5,575 tons, against 2,018 tons in 1919. The company retimbered the shaft to the 500-foot level and repaired it to the 1,300-foot level.

In 1920 the Tintic Standard mine, at Dividend, was second in the output of silver and third in the output of lead in the district and in the State. Ore was mined from the 1,100-foot level and those below it to the 1,450-foot level. More than 70,000 tons of ore was shipped directly to the smelters, part of which was lead sulphide, containing an average of 0.026 ounce of gold and 30.6 ounces of silver to the ton, 0.5 per cent of copper, and 12.9 per cent of lead. Another grade of shipping ore was highly siliceous and contained an average of 0.024 ounce of gold and 28.6 ounces of silver to the ton, 0.47 per cent of copper, and 3.3 per cent of lead. The Goshen Valley Railroad was completed to this mine and to the Iron King mine. A milling plant was completed at Warm Creek or Harold, 12 miles from the mine, and it is expected will be in operation in 1921. The chloridizing-roasting process will be used in the treatment of low-grade ore, of which the Standard mine is said to have a large reserve. Dividends paid during 1920 amounted to $587,350, which makes a total of $1,429,962 paid to stockholders.

Since the completion of the railroad to the Iron King mine considerable oxidized iron fluxing ore has been shipped to the smelters.

As a result of better labor conditions, the Eagle & Blue Bell mine [5] increased its ore shipments from 22,174 dry tons in 1919 to 29,640

[5] Eagle & Blue Bell Mining Co. Ann. Rept. for year ending Dec. 31, 1920.

dry tons in 1920. These shipments consisted of 24,312 tons of lead carbonate ore and 5,328 tons of siliceous ore. The lead ore contained 2,471.23 ounces of gold, 456,991 ounces of silver, and 5,408,375 pounds of lead; and the siliceous ore 707.28 ounces of gold, 71,315 ounces of silver, and 1,095 pounds of copper. After charges for freight, smelting, and sampling were deducted, the net smelter returns amounted to $544,568.50. Dividends distributed in 1920 amounted to $312,601, of which $133.971.90 was paid from reserve for depletion account as return of capital. The total dividends to date amount to $1,563,005.50. No work was done on or above the 1,000-foot level in 1920, but on the 1,200-foot level two new ore bodies were found. Most of the ore produced came from the stopes above the 1,350-foot level. A drift followed along a strong cross fracture on the 2.000-foot level opened up a large body of low-grade quartz ore.

The Victoria mine [6] adjoins the Eagle & Blue Bell mine and is operated through the latter's No. 1 shaft. A large output of silver-lead ore was mined from the No. 219 ore body, which extended from the workings above the 1,350-foot level of the Eagle & Blue Bell mine into Victoria ground. From the 1,550-foot level No. 203 crosscut was driven east to a point almost vertically below the Victoria shaft. Two ore bodies were found, one of silver-lead ore and the other the characteristic siliceous ore containing gold and silver. The output in 1920 was 6,771 dry tons of silver-lead ore, containing 613.72 ounces of gold, 112,980 ounces of silver, 1,540,022 pounds of lead, and 1,694 pounds of copper; and 5,297 dry tons of siliceous ore, containing 890.05 ounces of gold, 70,083 ounces of silver, and 8,093 pounds of copper. Smelter returns on both grades of ore amounted to $158,743. 29.

Ore sales of the Dragon property amounted to $93,439.14 in 1920 for iron fluxing ore and some oxidized iron ore, containing an average of $16.95 in gold and 6.28 ounces of silver a ton. Both the gold ore and the silver ore from this property contain less than 1 per cent of copper. The silver ore was treated at the Silver City mill.

Considerable development work was done at the Iron Blossom mine, but no new ore was opened by the company. Shipments of four grades of ore were made to the smelters by lessees who produced siliceous ore containing silver, copper oxidized ore, and lead ore. Silver ore of milling grade was shipped to the Silver City plant. The total ore shipped was valued at $359,641.85.

The Mammoth, Grand Central, and Gold Chain properties produced less ore than formerly, owing to the low price of copper. Very little ore was mined from the Eureka Hill mine or the property of the Eureka Mines Co., but the Gemini and Ridge & Valley mines, which produce high-grade silver-lead ore, were regular shippers. The Tintic Drain Tunnel Co. continued work on its drainage adit part of the year and shipped small lots of ore from two of its claims.

Most of the mines producing in the southern part of the Tintic district shipped low-grade siliceous and sulphide ore containing silver to the Tintic mill at Silver City. Among the shippers were the Laclede, Martha Washington, Primrose, Rabbit's Foot, Swansea, Sunbeam, Monterey, and Alaska. Copper ore was also shipped from the Alaska mine and some lead ore from the Silver Park mine.

[6] Bingham Mines Co. Twelfth Ann. Rept., for year ending Dec. 31, 1920.

The Tintic Milling Co. shipped a large part of its bullion, containing silver, gold, and copper, to copper refiners during 1920. The last part of the year its own refinery was operated, turning out silver bullion which was shipped directly to the mint and the copper bullion to a refinery in the West. A flow sheet with descriptive article of the milling plant was given in a recent paper.[7]

West Tintic district.—The Imperial Lead property produced considerable oxidized lead ore, containing silver, which was shipped to the smelters from Lucern, Utah.

MILLARD COUNTY.

No production of ore was recorded by any of the mine operators in Millard County in 1920.

MORGAN COUNTY.

Morgan district.—The property of the Tunnel Hollow Mining Co. is about 6 miles east of Morgan. The ore produced in 1920 is reported [8] to have been mined from a belt of sandstone similar to that containing the silver deposits of the Silver Reef district, in Washington County. The prospect is in Tunnel Hollow and while under development yielded a small shipment of copper ore, largely chalcocite, containing silver. Considerable development work was done by shallow workings without finding much ore.

PIUTE COUNTY.

Mount Baldy district.—Important mining operations continued at the Deer Trail mine, where considerable ore was produced, most of which was milled. Concentrates containing gold and silver, cyanide precipitates, and some lead ore were shipped in 1920.

Ohio district.—Four producers in the Ohio district reported mining 137 tons of ore, valued at $4,254. Most of the ore, which was of smelting grade, contained silver. The ore from the Wedge mine was rich in gold.

SALT LAKE COUNTY.

Big and Little Cottonwood districts.—The mines producing in 1920 in the Big Cottonwood district were the Cardiff, Howell, Iowa Copper, Maxfield, Prince of Wales, and Woodlawn. Most of the ore, containing lead, was from the Cardiff property. The total output of the district amounted to 7,333 tons, valued at $454,376, or an average of $61.96 a ton.

Nine producers in the Little Cottonwood district reported 10,966 tons of ore shipped, containing principally silver and lead, amounting in value to $547,639, or an average of $49.94 a ton. The largest producer was the Columbus-Rexall, followed by the South Hecla, Michigan-Utah, and Emma Silver mines. Other producers were the

[7] Holt, T. P., Chloride roasting and leaching at the plant of the Tintic Milling Co.: Min. and Sci. Press, vol. 120, pp. 603-604, Apr. 24, 1920; see also earlier descriptions in Am. Inst. Min. Eng. Trans., vol. 49, p. 183; Min. and Sci. Press, Aug. 29, 1914; and Eng. and Min. Jour., Feb. 6, 13, 1915.

[8] Maguire, Don, The silver-copper mine of the Panama Reef, Morgan County: Salt Lake Min. Review, Aug. 15, 1920, p. 37.

Sells, Alta Consolidated, Cabin, Wasatch Mines, and Louise. The output of the Cottonwood districts is combined in the table following:

Mine production in Big Cottonwood and Little Cottonwood mining districts, Utah, 1919–20.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	19	21,766	$7,947	321,426	916,049	4,857,211	.....	$795,761
1920	15	18,299	6,806	413,863	566,003	5,499,436	.....	1,002,015
Increase or decrease, 1920.	−4	−3,467	−1,141	+92,437	−350,046	+642,225	.....	+206,254
Total, 1867–1920	.....	504,829	527,348	14,357,770	13,053,938	196,980,685	322,055	28,864,992

The South Hecla mine[9] produced 3,580 dry tons of ore, containing 56,452 ounces of silver, 161.14 ounces of gold, 329,836 pounds of lead, and 12,395 pounds of copper. An account of new ore developments from the company's annual report follows:

During the year the ore developments on company account have been confined mostly to the Wedge vein which had been opened near the western end of the property by the so-called Wedge shaft, and levels driven along the vein at an average depth of 350 feet on its dip, and by some limited but important workings on the eastern end of the vein system over a mile away from the main development. The development carried on in the Wedge vein during this year was from the 500 and 600 foot levels. The lead stopes on the west side of the mine were opened on the 500 and 600 foot levels, and the ore bodies on these levels appear to be fully as large as on any of the levels above, and the grade of same is much better both in silver and copper content. During the early part of the year exploration work was commenced on the eastern end of the vein system in the sulphide zone, and where the Wedge vein was penetrated a large body of copper-silver-sulphide ore was encountered.

In 1913 the Wasatch Mines Co. began driving an adit to the east, which at the end of 1920 was 5,538 feet from its portal. At a distance of 5,300 feet from the portal a crosscut was started in a northerly direction to explore the ground and unwater the Columbus workings. Some copper-lead ore was shipped from old workings by a lessee.

From the Emma mine[10] 1,484 tons of silver ore was produced in 1920, for which the smelter paid $49,657. The ore came from a point below the 300-foot level in the winze from the Bay City tunnel. Drifting on the Bay City tunnel level is developing the Phoenix fissure, which is in ground not heretofore prospected.

Smelter district.—The old tailing at the Midvale plant was retreated by a lessee, who shipped considerable zinc concentrate containing lead and silver. Included in the district output was some old slag sorted from the smelter dumps and ore picked up in the railroad yards.

At the Murray lead plant and the Midvale works less custom ore was treated than usual. The United States smelter and mills suffered from curtailment and treated only 106,874 tons of crude ore by concentration, compared with 135,782 tons in 1919. The smelter

[9] South Hecla Mining Co. Ann. Rept. for year ending Dec. 31, 1920.
[10] Emma Silver Mines Co. Ann. Rept. for year ending Sept. 30, 1920.

reduced 215,757 tons of marginal ores, against 222,666 tons in 1919. The company's annual report[11] says:

The lead bullion production amounted to 31,740 tons in comparison with 32,580 tons for 1919. Research of new methods or processes, particularly for recovery of pigments from complex products, was continued. Various small betterments and improvements were installed for the purpose of increasing efficiency or for economy, and the plant, in general, has been kept in splendid physical condition. Additions were made for increased production of white arsenic, but the beneficial result will not be indicated until the early part of 1921. The litigation with farmers in the vicinity of Midvale, spoken of in the 1919 annual report, and which resulted in an investigation of crop conditions for 1920 by a commissioner appointed by the Federal court, is still unsettled, although the survey has been completed.

Bingham or West Mountain district.—The metal output of the Bingham district is shown in the accompanying table.

Mine production in Bingham or West Mountain district, Utah, 1919–1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	29	6,086,379	$1,389,849	1,607,132	116,696,528	54,610,987	2,566,376	$27,977,118
1920	31	6,067,180	[a]1,054,915	[a]1,589,972	110,670,055	52,488,597	2,113,741	27,521,576
Increase or decrease, 1920	+ 2	− 19,199	− 334,934	− 17,160	− 6,026,473	− 2,122,390	− 452,635	− 455,542
Total, 1865–1920	.....	.....	35,818,959	54,050,686	2,097,198,310	1,244,965,272	50,471,985	538,043,432
Total dividends, 1865–1920	.....	.....	.....	.....	.....	.....	.....	122,319,363

[a] Includes small placer production.

The average value of the ore produced in the district in 1920 was $4.54 a ton, against $4.60 in 1919; the shipments of ore to the smelters amounted to 188,454 tons, against 258,781 tons; the output of concentrating ore was 5,728,723 tons, against 5,827,598 tons; and the quantity of concentrates produced was 375,204 tons, against 339,648 tons.

The crude smelting ore consisted principally of low-grade copper and lead sulphides and contained 9,960.42 ounces of gold, 858,877 ounces of silver, 5,943,372 pounds of copper, and 28,252,293 pounds of lead, valued in all at $4,495,840, or $23.86 a ton. Milling ores produced 375,204 tons of copper, lead, and zinc concentrates that contained 41,065.18 ounces of gold, 731,092 ounces of silver, 102,719,821 pounds of copper, 24,236,304 pounds of lead, and 2,113,741 pounds of recoverable zinc, valued in all at $22,656,346, or $60. 38 a ton.

Ore and metals produced in Bingham district, Utah, in 1920.

Source of production.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Placers	1	.....	5.92	3	.....	.....	.....
Dry or siliceous ore	4	17,134	1,657.83	114,510	533,467	321,330	.....
Copper ore	11	5,770,914	30,916.99	371,599	107,682,094	808	.....
Lead ore	22	176,966	5,200.72	759,695	1,949,433	37,414,771	.....
Copper-lead ore	1	424	52.58	11,999	23,408	87,912	.....
Lead-zinc ore	6	101,742	13,197.48	332,166	481,653	14,663,776	2,113,741
	.....	6,067,180	51,031.52	1,589,972	110,670,055	52,488,597	2,113,741

[11] United States Smelting, Refining & Mining Co. Fifteenth Ann. Rept., for year ending Dec. 31, 1920.

The United States Co.'s mines [12] produced 102,842 wet tons of complex lead-zinc ore, against 137,916 tons in 1919. Lead and zinc concentrates are recovered in the milling plant of the company at Midvale, the lead product is smelted, and the zinc concentrate is treated at eastern refineries. The company's report contains the following paragraph:

The shortage of labor accounts largely for decreased production and also prevented as extensive development as planned for the year; but the important work of sinking an underground shaft from the previous low level of the mines to a depth of 228 feet was started and practically completed. It is expected that stoping of ore from the well-known productive fissures in the property on this new lowest level will enable your company to increase its output in the new year if conditions of the metal market seem to warrant.

The Utah Copper Co.[13] produced 5,556,800 tons of concentrating copper ore from the porphyry ore body by steam shovels and also mined and delivered to the leaching plant 187,265 dry tons of carbonate ore. The entire output averaged 1.374 per cent of copper. All concentrating ore was treated at the Arthur plant, the Magna plant being idle throughout the year. The total ore milled averaged 1.16 per cent of copper, and the average recovery was 81.38 per cent, corresponding to 18.83 pounds of copper to the ton. The average cost of milling was $1.25 a ton, and that of mining, with all fixed and general charges except Federal taxes, was 48.23 cents a ton, of which 12.50 cents represents charges of stripping. The direct cost was 35.73 cents a ton—24.52 cents for all charges at the mine and 11.21 cents for fixed and general charges. The following is taken from the company report:

The leaching plant was operated intermittently during the year. These operations were conducted at considerable disadvantage on account of shortage of sulphuric acid. A total of 150,003 tons of oxidized ore was treated in this plant. The ore averaged 0.72 per cent copper, of which 0.61 per cent was in soluble form. The recovery in leaching was 8.87 pounds per ton, corresponding to an extraction of 72.54 per cent of the soluble copper. The recovery of the metal from the solution in the form of precipitate was 98.27 per cent, or 8.71 pounds of copper per ton of ore leached. The precipitate averaged 51.70 per cent copper, 10.91 per cent iron, and 5.16 per cent insoluble. Irregular operation and small tonnage coupled with high costs of everything resulted in an operating loss in this department.

The concentrates were of an average grade of 16.45 per cent copper and yielded a total of 104,616,988 pounds, as compared with 19.86 per cent copper and 109,234,920 pounds, respectively, for the previous year. The lower grade of the ore and concentrates and decrease in production were due to the large quantity of very low-grade ore necessarily shipped from intermediate and upper steam shovel levels. The gross production of copper from all sources, as compared with 1915, 1916, 1917, 1918, and 1919, was as follows:

Quarter.	1915	1916	1917	1918	1919	1920
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
First	26,415,995	36,673,007	43,060,450	41,276,750	29,261,209	27,257,546
Second	40,799,825	48,726,304	56,845,059	52,724,053	28,046,978	29,004,381
Third	44,766,841	61,181,870	54,999,468	54,739,678	25,269,679	25,331,217
Fourth	44,224,715	50,836,299	51,269,465	49,238,076	28,013,742	25,079,143
	156,207,376	197,417,480	206,174,442	197,978,557	110,591,608	106,672,287

The average cost per pound of net copper produced from concentrates only was 15.124 cents, and the average cost of all net copper produced was 15.237 cents, as compared with 14.145 cents for the previous year, the increase arising entirely from the higher cost on the items of labor, supplies, freight, and smelting and refining. These

[12] United States Smelting, Refining & Mining Co. Fifteenth Ann. Rept., for year ending Dec. 31, 1920.
[13] Utah Copper Co. Sixteenth Ann. Rept., for year ending Dec. 31, 1920.

costs include depreciation, local and State taxes, fixed, general, and maintenance charges of every kind, and all expense of smelting, transportation, refining, and selling. No credits are taken in these figures for income derived from gold and silver or from miscellaneous sources. The net value of the gold and silver recovered was 0.814 cent per pound, and the miscellaneous income in Utah, including that from the Bingham & Garfield Railway, amounted to 1.278 cents per pound, making a total income from these sources of 2.092 cents per pound, which, being deducted from the cost above stated, leaves a net cost including depreciation of 13.145 cents per pound. * * *

Effective September 1, 1920, the company took over the delivery of its ores from the mines at Bingham to the leaching plant and concentrators at Garfield, operating its own ore trains in intra-industry service in accordance with a trackage rental agreement with the Bingham & Garfield Railway Co. During the last four months of the year 2,092,676 tons of ore were so handled. This arrangement whereby the operating control of the mines, the delivery to the plants, and the treating of the ores is centralized in the management of the mining company had been under consideration for some time in the interest of efficiency and economy, and results have fully justified its adoption.

The Dalton & Lark mines [14] were worked profitably on company account and by lessees, owing to the relatively large quantity of silver in both lead and copper ores. The Commercial mine also produced lead ore mined by lessees, but the bulk of the ore was mined from the Brooklyn workings. Altogether the lessees mined from both properties 6,763 dry tons of ore, on which the company received as royalty the sum of $64,615. The company's output in 1920, exclusive of ore mined by lessees, was as follows:

Mine production by Dalton & Lark mines, Bingham district, Utah, 1920.

Kind of ore.	Ore.	Gold.	Silver.	Lead.	Copper.	Gross value.	Smelter returns.
	Dry tons.	*Ounces.*	*Ounces.*	*Pounds.*	*Pounds.*		
Lead ore	1,194.91	337.85	8,491.83	311,289	28,662	$36,610.73	$26,517.04
Copper ore	15,112.17	1,589.79	73,722.41	.....	450,580	141,821.85	96,876.99
	16,307.08	1,927.64	82,214.24	311,289	479,242	178,432.58	123,394.03
Company and lease ore produced, 1909–1920	.....	31,278	2,622,014	14,221,327	38,037,853	.....	.....

At the Highland Boy mine [15] a curtailment in operation and consequently in production was caused by a shortage of labor. In the fourth quarter of 1920 copper shipments were suspended. The ore produced contained 3,187,492 pounds of copper, 9,999,350 pounds of lead, 273,730 ounces of silver, and 4,697 ounces of gold. A concentration mill having a capacity of 1,000 tons a day has been built near the terminus of the Highland Boy aerial tramway at International, Utah. It will make available the low-grade copper ores developed in the mine. The company report gives the following figures:

Average assay per ton of crude ore shipped from the Highland Boy mine, Utah, in 1920.

Material.	Dry ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Per cent.*	*Per cent.*
Copper-iron sulphide ore:					
To International, Utah	52,961	0.054	1.38	2.48	.....
To Garfield, Utah	4,786	.036	.78	2.20	.....
Lead sulphide ore:					
To International, Utah	44,427	.039	4.85	.85	14.00

[14] Bingham Mines Co. Twelfth Ann. Rept., for year ending Dec. 31, 1920.
[15] Utah Consolidated Mining Co. Ann. Rept., for year ending Dec. 31, 1920.

The Yosemite mines[16] produced 366 dry tons of lead ore, containing 25.53 ounces of gold, 2,508.89 ounces of silver, 93,672 pounds of lead, and 6,422 pounds of copper.

From the property of the Utah Metal & Tunnel Co. 10,181 dry tons of ore was produced, which averaged 0.071 ounce of gold and 8.74 ounces of silver to the ton, 14.54 per cent of lead, and 0.96 per cent of copper. The gross ore sales amounted to $271,002.77.

The Utah Apex Mining Co.[17] produced during its fiscal year 66,241 tons of crude lead ore, 292 tons of sorted lead ore, 786 tons of copper-lead ore, 586 tons of copper ore, and 41,673 tons of lead mill ore. The ores mined, most of which were sulphide, contained 2,731.57 ounces of gold, 352,663 ounces of silver, 22,300,652 pounds of lead, and 788,142 pounds of copper, A small part of 9,496,169 pounds of zinc contained in the ores was saved at the concentrator and electrostatic zinc plant of the United States smelter at Midvale, where some ore of milling grade was shipped. The bulk of the zinc was lost in lead ore and concentrate smelted. The total receipts from the smelters amounted to $1,785,177.18. The concentration mill of the company was operated from February 1 to December 20. No ore was produced after December 16 on account of the low prices of lead and zinc. A dividend of 25 cents a share was paid to stockholders in November.

The Montana-Bingham Co.[18] by an agreement entered into in December with the Bingham Central Railway (Ohio Copper Co.) is permitted to develop its property through the Mascotte tunnel, which is approximately 475 feet vertically, or 1,000 feet on the dip of the vein, below the Montana-Bingham tunnel. During 1920 several new shoots of high-grade ore were opened and considerable low-grade copper-iron sulphide rock was developed, which can not be classed as ore under present conditions. Shipments of copper ore amounted to 4,397.7 dry tons, containing an average of 0.079 ounce of gold and 2.79 ounces of silver per ton and 8.52 per cent of copper. Of lead ore there was 35.8 tons, averaging 0.082 ounce of gold and 11.52 ounces of silver per ton, 22.7 per cent of lead, and 1.36 per cent of copper. In addition to the above, lessees shipped 815 wet tons of copper and lead ore. The total value of the company ore was $108,121.05, and the smelter returns amounted to $79,382.77.

Other producers shipping lead ore were the Bazook, Castro, New England, Bingham-Coalition, Silver Shield, Utah Lead & Copper, and Winnemuck mines. Those shipping copper ore were the Congor and the Quinn group. Copper-lead ore was shipped from the Utah Bingham property, and gold-silver siliceous ore from the Spring & Summit property.

SAN JUAN COUNTY.

Development of the Big Indian mine, in the La Sal district, was continued, but the Buena Vista mill which was erected to treat the ore was not completed, owing to financial difficulties. A small quantity of placer gold was recovered from sand bars in the White Canyon district. On San Juan River near Bluff miners produced some placer gold by skimming off the surface of the bars down to a

[16] Bingham Mines Co. Twelfth Ann. Rept., for year ending Dec. 31, 1920.
[17] Utah Apex Mining Co. Ann. Rept., for year ending Aug. 31, 1920.
[18] Montana-Bingham Consolidated Mining Co. Ann. Rept., for year ending Dec. 31, 1920.

blue silt which carries most of the gold. The silt is dried and washed in rockers. Some of the gold is sent through Bluff to Durango, Colo., which is easily reached from Bluff.

SUMMIT AND WASATCH COUNTIES.

The Park City region embraces the Snake Creek, Blue Ledge, and Uinta districts, covering the principal producing area in Summit and Wasatch counties. Each of these districts was productive in 1920.

Mine production in Park City mining region, Utah, 1919–20.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	11	147,850	$69,502	1,945,670	760,858	21,311,284	1,279,556	$3,613,078
1920	14	173,869	83,900	2,672,389	1,156,772	25,732,104	3,442,445	5,547,056
Increase, 1920	3	26,019	14,398	726,719	395,914	4,420,820	2,162,889	1,933,978
Total, 1870–1920			4,603,041	142,490,455	33,861,835	1,323,808,326	74,344,120	183,894,311
Total dividends, 1870–1920								44,912,115

The Silver King Coalition mine [19] produced 25,103.9 dry tons of mixed lead carbonate and sulphide ore, which was milled and yielded 4,568 tons of concentrate. Of the shipping ore, 14,517.37 tons was mined by the company and 1,849 tons of a slightly higher grade was mined by lessees. The average assay contents of these products were reported as follows:

Gold, silver, copper, and lead produced by Silver King Coalition mine, Utah, 1920.

Kind of material.	Gold.		Silver.		Lead.		Copper.		Net smelter returns.	
	Per ton.	Total.	Per ton.	Total.	Percentage.	Total.	Percentage.	Total.	Total.	Per ton.
	Ounce.	*Ounces.*	*Ounces.*	*Ounces.*		*Pounds.*		*Pounds.*		
First-class ore	0.063	924.25	32.04	465,310	25.31	7,351,405	0.59	173,778	$807,862	$55.63
Concentrates	.064	294.19	20.73	94,715	24.84	2,270,229	.25	23,258	198,825	43.53
Lessees' ore	.090	167.04	37.80	69,904	26.58	982,819	.91	33,583	116,873	63.21
		1,385.48		629,929		10,604,453		230,619	1,123,560	

In addition to the above products shipped to the smelter, 1,048 tons of middlings, averaging 5.4 ounces of silver per ton and 5.5 per cent of lead, was stored for treatment by flotation. On January 27, 1921, fire destroyed the entire concentrating plant, which is to be replaced by a steel structure.

At the Silver King Consolidated property [20] little work was done other than driving the Spiro adit, which at the end of 1920 was 14,110 feet from the portal. Lessees shipped from the upper workings 438

[19] Silver King Coalition Mines Co. Ann. Rept., for year ending Dec. 31, 1920.
[20] Silver King Consolidated Mining Co. Ann. Rept., for the year ending Dec. 31, 1920.

dry tons of ore, which contained 27.26 ounces of gold, 12,721 ounces of silver, 234,509 pounds of lead, and 1,375 pounds of copper, and had a net value of $26,304.72.

The total output of the Daly West mine [21] in 1920 was 22,002 tons of ore, of which 10,825 tons was of shipping grade.

Average metal content of ore and concentrate sold from Daly West mine, 1920.

Material.	Quantity.	Gold.	Silver.	Copper.	Lead.	Value sold for.
	Dry tons.	*Ounce per ton.*	*Ounces per ton.*	*Per cent.*	*Per cent.*	*Per ton.*
Crude ore	10,825	0.0327	42.15	1.58	10.88	$54.21
Concentrate	1,909	.0200	25.76	.....	26.42	30.37

In May, 1921, the Daly West Co. joined with the Judge Co. and the Park-Utah Co. in the purchase of the controlling interest in the Daly Mining Co.

The output of ore by the Judge mines [22] was 41,316 tons, of which 9,150 tons was of shipping grade. The metal content of ore and concentrate sold was 483,890 ounces of silver, 649 ounces of gold, 7,877,121 pounds of lead, and 359,186 pounds of copper. The electrolytic plant produced 2,808,000 pounds of zinc of premium grade. Unsold products on hand January 1, 1920, were 1,414,100 pounds of premium zinc and 1,033 tons of zinc concentrates. The following table is taken from the company report:

Average metal content of ore and concentrate from the Judge mines, Utah, 1920.

Kind of material.	Ore (dry).	Gold (per ton).	Silver (per ton).	Copper.	Lead.	Zinc.	Iron.	Price per ton.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
Crude ore (mixed with 427 tons of zinc plant residues)	9,577	0.033	26.22	1.01	13.61	8.63	9.01	$29.42
Lead concentrate (mixed with 817 tons of zinc plant residues)	9,407	.031	22.13	.64	26.52	9.69	19.91	45.58
Zinc plant residues (additional)	1,970	.025	19.08	.83	5.52	.....	.....	17.29
Zinc dross	193	.....	.....	.....	.....	89.75	.....	88.89
Premium zinc	1,548	.....	.....	.....	.....	99.9+	.....	158.75

Dividends paid by the Judge Co. to stockholders in 1920 amounted to $180,000, which makes the total paid since incorporation $2,550,000.

In October the electrolytic zinc plant was closed and the zinc concentrate, of which 1,000 tons was stored at the concentration mill, was held pending the resumption of operations. A description of the zinc plant, with the flow sheet, was given by George C. Heikes in the Engineering and Mining Journal of December 11, 1920.

The development of the Ontario mine [23] was retarded in 1920 by the shortage of labor. Most of the ore produced in 1920 was mined from the 1,800-foot level. The 2,000-foot level, the lowest one in the mine, was unwatered during the year after having been flooded for 20 years. The extent of the ore on this level has not been determined. Ore sales in 1920 amounted to $551,369.04.

[21] Daly West Mining Co. Ann. Rept., for year ending Dec. 31, 1920.
[22] Judge Mining & Smelting Co. Ann. Rept., for year ending Dec. 31, 1920.
[23] Ontario Silver Mining Co. Ann. Rept., for year ending Dec. 31, 1920.

Other producers in the region were the Naildriver, Keystone, Daly, and American Flag mines, and the operators of tailing plants.

TOOELE COUNTY.

Mine production in Tooele County, Utah, 1919–1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	30	87,339	$16,032	520,169	1,512,157	12,311,455	398,355	$1,561,469
1920	27	105,826	10,178	498,393	1,203,677	10,272,259	807,849	1,662,120
Increase or decrease, 1920..	−3	+18,487	−5,854	−21,776	−308,480	−2,039,196	+409,494	+100,651

Clifton district (*Gold Hill*).—The output of ore in the Clifton district, amounting to 39,656 tons, was mined by 9 operators and contained $1,601 in gold, 89,578 ounces of silver, 92,913 pounds of copper, and 1,010,833 pounds of lead, valued in all at $197,204, or an average of $4.97 a ton. The largest part of this output was that of the Gold Hill property of the Western Utah Copper Co., which sold most of its ore under contract on a flat rate basis. Besides small quantities of gold, silver, copper, and lead, the Gold Hill ore contains an average of about 12 per cent of arsenic.

Other producers in the district were the Ararat, Monoco, Silver King, and Success claims.

Columbia district (*Vernon*).—The Sharp Lead property yielded a small lot of oxidized lead ore.

Dugway district.—Some ore containing principally lead was shipped from the Golconda property.

North Tintic district (*Lofgreen*).—Oxidized zinc ore from the Scranton mine was shipped to a zinc plant in Colorado and to the Utah Zinc Co.'s plant near Salt Lake City.

Ophir district.—Seven producers in the Ophir district reported the output of 61,119 tons of ore, the larger part of which was milled and yielded 16,054 tons of concentrate, containing lead, copper, and silver, with a little gold. The shipping ores amounted to 17,322 tons and contained 114.93 ounces of gold, 200,299 ounces of silver, 630,734 pounds of copper, and 3,771,329 pounds of lead. The total output of the district contained $4,648 in gold, 380,077 ounces of silver, 1,095,282 pounds of copper, 7,637,362 pounds of lead, and 52,794 pounds of recoverable zinc, valued in all at $1,235,729, or $20.22 a ton. The principal producers were the Ophir Hill, Montana & Lost Boy, Hidden Treasure, and Cliff mines. Other producers were the Buffalo, Brooklyn, and Surprise Tunnel. Some ore was also reported from the Chloride Point property, recently purchased by the Ophir Metals Co.

Rush Valley district (*Stockton*).—Six producers in the Rush Valley district reported the mining of 3,103 tons of ore, all of shipping grade, containing $3,927 in gold, 26,978 ounces of silver, 13,259 pounds of copper, 1,553,273 pounds of lead, and 25,143 pounds of recoverable zinc, valued in all at $162,072, or $52.23 a ton. The Honerine prop-

erty of the Bullion Coalition Mines Co. was operated by lessees, who shipped the largest part of the ore mined in the district. The Galena King, Calumet, Southport, Cyclone, and Ben Harrison mines were also producers.

Wild Cat Range district.—Considerable high-grade fluorite was mined and shipped from the Wild Cat Range district to steel works in Utah, and some silver ore containing copper was smelted at Garfield, Utah.

UINTAH COUNTY.

A small production of placer bullion resulted from prospecting the sands of Green River in Uintah County.

UTAH COUNTY.

American Fork district.—The ore produced in the American Fork district in 1920 amounted to 49 tons, all lead ore of shipping grade. Producers were the Dutchman, Live Yankee, and Bellerophon mines.

Mine production in American Fork district, Utah, 1919–1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	4	116	$934	1,583	3,649	45,917	.....	$5,820
1920	3	49	11	296	179	18,619	.....	1,856
Decrease, 1920.	1	67	923	1,287	3,470	27,298	.....	3,964
Total, 1870–1920	.....	76,257	273,279	1,924,340	177,870	30,073,122	46,911	4,043,192

Tintic district.—The Tintic Standard and Colorado Consolidated mines were the two principal producers of lead ore and siliceous silver ore in the eastern part of the Tintic district. The Yankee, May Day, Sioux, and Eureka Bullion properties also produced lead ore.

WASHINGTON COUNTY.

Harrisburg district.—Development of the old Silver Reef mines was carried on during 1920. According to engineers who have examined the mines, there is developed approximately 2,000,000 tons of ore which will average 10 ounces of silver to the ton and 1 per cent of copper.

Tutsagubet district.—The Dixie mine was operated by the Utah Southern Mining Co., which shipped copper ore containing a little silver to International, Utah.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA.[1]

(MINES REPORT.)

By V. C. Heikes.

PRODUCTION.

GENERAL STATEMENT.

A gradual improvement in labor conditions and the protection given by the Pittman Act to silver producers stimulated the output of silver, lead, and zinc ores in Nevada in 1920. Six mining companies, some of which owned property in other States, paid dividends amounting to $2,070,152.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total. value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	421	3,187,831	$4,541,502	6,863,580	52,331,175	15,349,370	9,004,698	$23,433,171
1920	473	3,480,620	3,566,728	7,745,093	50,559,763	21,263,700	10,698,040	23,879,512
Increase or decrease, 1920	+52	+292,789	−974,774	+881,513	−1,771,412	+5,914,330	+1,693,342	+446,341
Total, 1904–1920	.....	59,499,927	176,266,307	180,849,658	963,076,250	221,538,871	172,415,063	506,934,025

[a] Includes placer production.

ORE.

The largest increases in production of ore were in White Pine, Nye, and Lincoln counties. The output of dry or siliceous ores increased from 783,567 tons in 1919 to 799,207 tons in 1920. Under this classification for 1920 are included 102,772 tons of low-grade siliceous gold ores, averaging $9.83 in gold and 0.57 ounce of silver to the ton and carrying small quantities of copper and lead. Dry or siliceous gold and silver mixed ores, aggregated 76,863 tons and averaged $6.51 in gold and 6.65 ounces of silver to the ton. Some of these ores contained small quantities of copper and lead. The output of siliceous silver ores amounted to 619,572 tons, mined by 151 producers

[1] Valuable assistance in the preparation of the report and the compilation of statistical tables has been rendered by B. N. Patchell, of the United States Geological Survey.

and averaging $2.10 in gold and 10.28 ounces of silver to the ton. Included in the output of silver ore was 104,487 tons of iron-manganese ore containing lead and small quantities of gold and silver, produced in the Pioche district.

The output of lead ore of smelting grade amounted to 29,577 tons. The oxidized ore, largely carbonates, in this smelting ore increased from 10,392 tons in 1919 to 20,213 tons in 1920 and averaged $2.31 in gold, 16.70 ounces of silver, 1.34 pounds of copper, 400.53 pounds of lead, and $52.80 in total value to the ton. The sulphide lead ores of smelting grade amounted to 9,364 tons and averaged $1.60 in gold, 14.06 ounces of silver, 13.79 pounds of copper, 265.62 pounds of lead, and $40.71 in total value to the ton. The output of zinc ores of shipping grade decreased from 4,867 to 2,898 tons. They were all oxidized or carbonate ores and averaged 0.88 pound of lead and 713.21 pounds of recoverable zinc per ton. The production of copper-lead ores increased from 4,996 to 6,269 tons, of which 5,879 tons was shipped directly to smelters. All the first-class ore was oxidized or carbonate copper-lead ores, averaging $10.16 in gold, 19.43 ounces of silver, 63.55 pounds of copper, 227.64 pounds of lead, and $61.25 in total value to the ton. There was 15,465 tons of lead-zinc ore produced, nearly all of which (14,375 tons), was concentrated into 1,907 tons of lead concentrate and 11,993 tons of zinc concentrate. The remainder was lead-zinc ore of shipping grade, all of which was oxidized.

The output of milling ores was 3,270,924 tons, of which 648,871 tons was treated either by amalgamation or cyanidation, and 2,622,053 tons by concentration, followed by smelting. The 607,170 tons of ore and 33,520 tons of tailings treated by cyanidation contained an average per ton of $3.45 in gold and 9.75 ounces of silver. The ores amalgamated (41,701 tons) yielded bullion averaging per ton $8.73 in gold and 0.30 ounce of silver.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1920.

Source of production.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Placers	39	.....	7,383.91	3,296	.....	.....	.....
Dry or siliceous ore	278	799,207	136,058.51	6,939,579	168,534	5,789,125	.....
Copper ore	36	2,616,237	22,924.19	82,977	49,858,120	4,871	.....
Lead ore	122	40,544	3,237.01	520,971	158,364	11,111,973	.....
Zinc ore	3	2,898	.....	.....	.....	2,560	2,066,877
Copper-lead ore	6	6,269	2,936.41	114,358	374,745	1,340,286	.....
Lead-zinc ore	11	15,465	.43	83,912	.....	3,014,885	8,631,163
	.....	3,480,620	172,540.46	7,745,093	50,559,763	21,263,700	10,698,040

Ore sold or treated in Nevada in 1920, in short tons.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Churchill	1,257	.....	35	.....	.....	.....	1,292
Clark	10,929	200	1,302	1,118	910	15,443	29,902
Elko	55,635	503	8,622	.....	.....	.....	64,760
Esmeralda	23,660	35	603	.....	.....	.....	24,298
Eureka	4,477	9	4,484	.....	.....	.....	8,970
Humboldt	485	37	39	.....	.....	22	583
Lander	944	400	2,386	.....	.....	.....	3,730
Lincoln	104,487	769	7,188	.....	5,210	.....	117,654
Lyon	30,248	26,412	.....	.....	.....	.....	56,660
Mineral	7,744	359	340	.....	6	.....	8,449
Nye	422,086	.....	7,582	.....	.....	.....	429,668
Pershing	77,339	.....	244	.....	.....	.....	77,583
Storey	58,494	.....	.....	.....	.....	.....	58,494
Washoe	426	3	912	.....	.....	.....	1,341
White Pine	996	2,587,510	6,807	1,780	143	.....	2,597,236
	[a] 799,207	2,616,237	40,544	2,898	6,269	15,465	3,480,620
Average value per ton in gold and silver	$12.98	$0.22	$15.66	.....	$29.57	$5.91	$3.41

[a] Includes 102,772 tons of gold ore, 76,863 tons of gold and silver ore, and 619,572 tons of silver ore. The last named includes 102,252 tons of oxidized iron-manganese ore.

GOLD.

The gold produced at mines in Nevada in 1920 decreased $974,774 as compared with 1919. Nye County produced the largest output, and White Pine, Elko, Storey, and Esmeralda counties followed. Ore was treated by amalgamation in 13 counties and by cyanidation in 13 counties. From these two methods of treatment $2,577,619 in gold was produced from 648,871 tons of ore and 33,520 tons of old tailings. Placer gold was produced in greatest quantity in Nye, Lyon, and Lander counties, and the value of the total placer gold was $152,639, as against $132,288 in 1919. Most of the placer gold in 1920 was obtained by hydraulicking eroded vein material consisting of the disintegrated silicified rhyolite in the Round Mountain district. Gravel worked by drift mining and sluicing at Manhattan was next in value. At the Copper Basin placers, in the Battle Mountain district, a new producer began drifting on ground long known to be very rich. The installation of a 7,000-yard dredge, probably the largest ever operated in Nevada, which went into commission September 5, 1920, at Gold Canyon, in Lyon County, promises to add to the future output.

Ten producers supplied more than 62 per cent of the total gold in 1920. Their properties, which yielded more than 5,000 ounces each, were the Nevada Consolidated Copper mines, at Ely; Elkoro mines, at Jarbidge; Tonopah Belmont, Tonopah Extension, and West End, at Tonopah; Consolidated Virginia, at Virginia City; Tonopah Mining Co., at Tonopah; Round Mountain Mining Co. and Fairview Round Mountain, at Round Mountain; and Rochester Silver, at Rochester.

Mine production of gold in Nevada in 1920, in fine ounces.

County.	Placers.	Deep mines.					Total.
		Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	
Churchill		533.14		1.40			534.54
Clark		3,024.06	10.65	3.98	2,832.00		5,870.69
Elko	6.19	20,966.69	22.06	2.71			20,997.65
Esmeralda	22.35	10,449.97	99.35	45.19			10,616.86
Eureka	14.13	1,054.96	.05	2,015.25			3,084.39
Humboldt	26.03	1,313.04	.53	4.26		0.43	1,344.29
Lander	1,190.89	140.00	4.02	207.53			1,542.44
Lincoln		590.85	13.01	494.55	102.89		1,201.30
Lyon	1,314.30	4,289.41	.34				5,604.05
Mineral		4,242.78	.05	37.99	.17		4,280.99
Nye	4,769.82	66,601.05		203.76			71,574.63
Pershing	3.43	6,848.02		68.74			6,920.19
Storey		15,575.88					15,575.88
Washoe		372.15	.20	10.93			383.28
White Pine	36.77	56.51	22,773.93	140.72	1.35		23,009.28
	7,383.91	[a]136,058.51	22,924.19	3,237.01	2,936.41	.43	172,540.46

[a] Includes 48,873.75 ounces from gold ore, 24,216.14 ounces from gold and silver ore, and 62,968.62 ounces from silver ore.

SILVER.

The high price of silver in 1920 helped silver mining in Nevada. The mine production increased 881,513 ounces in quantity and $754,941 in value, as compared with 1919. Milling plants in Nye County were credited with 4,796,859 ounces, most of which (4,787,607 ounces) was recovered by cyanidation from ores treated principally in the Tonopah district. In the Rochester district, Pershing County, 579,744 ounces of silver was recovered by cyanidation. Concentrates from milling plants yielded 301,077 ounces of silver, against 281,454 ounces in 1919. Siliceous concentrates contained 99,973 ounces, against 91,877 ounces in 1919; and copper concentrates 65,529 ounces, against 55,646 ounces in 1919. Lead concentrates contained 135,440 ounces of silver, or an average per ton of 45.18 ounces, against 131,949 ounces, or an average of 47.07 ounces in 1919.

More than 59 per cent of the total silver was produced from the Tonopah Belmont, Tonopah Extension, West End, Tonopah Mining, and Montana Tonopah mines, all at Tonopah; and the Rochester Silver in Pershing County.

Mine production of silver in Nevada in 1920, in fine ounces.

County.	Placers.	Deep mines.					Total.
		Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	
Churchill		20,102		6,584			26,686
Clark		89,038	257	10,013	4,037	83,600	186,945
Elko		119,823	3,810	195,871			319,504
Esmeralda	3	285,229	437	3,216			288,885
Eureka	1	20,832	137	63,036			84,006
Humboldt	5	11,827	101	1,857		312	14,102
Lander	176	39,485	225	20,308			60,194
Lincoln		350,954	10,369	101,281	105,074		567,678
Lyon	726	89,519	4,040				94,285
Mineral		48,620	525	9,721	155		59,021
Nye	2,375	4,856,521		45,091			4,903,987
Pershing	1	646,108		7,560			653,669
Storey		324,744					324,744
Washoe		6,282	54	14,097			20,433
White Pine	9	30,495	63,022	42,336	5,092		140,954
	3,296	[a]6,939,579	82,977	520,971	114,358	83,912	7,745,093

[a] Includes 58,424 ounces from gold ore, 511,081 ounces from gold and silver ore, and 6,370,074 ounces from silver ore.

COPPER.

The mine production of copper in Nevada in 1920 decreased 1,771,412 pounds in quantity and $430,603 in value. The Nevada Consolidated Co., at Ely, in White Pine County, which operated at about half capacity, was the largest producer, followed by the Blue Stone mine, in the Yerington district, Lyon County. Other large producers were the Bristol Silver and Combined Metals mines, near Pioche; and the Richmond-Eureka mine, in Eureka County.

Mine production of copper in Nevada in 1920, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Total.
Clark	26	68,216	8,325	44,941	121,508
Elko	.....	143,720	3,979	.....	147,699
Esmeralda	9,818	3,868	276	.....	13,962
Eureka	108,302	615	12,112	.....	121,029
Humboldt	268	8,351	182	.....	8,801
Lander	1,077	90,135	865	.....	92,077
Lincoln	39,580	81,019	122,519	310,068	553,186
Lyon	.....	1,045,944	.....	.....	1,045,944
Mineral	661	68,667	881	677	70,886
Nye	106	.....	1,479	.....	1,585
Pershing	3,007	.....	744	.....	3,751
Washoe	4,973	628	1,263	.....	6,864
White Pine	716	48,346,957	5,739	19,059	48,372,471
	[a] 168,534	49,858,120	158,364	374,745	50,559,763

[a] Includes 115,831 pounds from gold ore, 2,043 pounds from gold and silver ore, and 50,660 pounds from silver ore.

LEAD.

The mine production of lead in Nevada in 1920 increased nearly 39 per cent. Lincoln County continued to have the largest output of lead, followed by Clark County and Elko County. More than 15 per cent of the lead was derived from the concentrates of milling ores, and nearly 84 per cent from crude ore shipped directly to smelters. Lead concentrates (carbonates and sulphides) shipped to smelters contained 2,558,645 pounds of lead, against 2,891,009 pounds in 1919, and averaged 42.67 per cent of lead, against 51.57 per cent in 1919. Zinc concentrates shipped in 1920 contained 629,000 pounds of lead and averaged 2.62 per cent. The total crude ore of shipping grade contained 17,795,649 pounds of lead, against 11,804,210 pounds in 1919. The iron-manganese ores, classified under dry or siliceous ores, contained 5,445,285 pounds of lead. Oxidized lead ore shipped to smelters contained 8,095,983 pounds of lead, and sulphide ore 2,487,263 pounds, against 4,899,614 and 782,121 pounds, respectively, in 1919. Zinc ores shipped produced 2,560 pounds of lead, all from oxidized ores. Copper-lead ore of shipping grade, all of which was oxidized, produced 1,338,323 pounds of lead. The oxidized lead-zinc ores of smelting grade produced 300,185 pounds of lead.

More than 70 per cent of the lead came from seven mines. The leading producer was the Prince Consolidated mine, near Pioche, Lincoln County, followed by the Yellow Pine mine, Clark County; the Spruce Monarch, Elko County; the Virginia Louise, Lincoln County; the Eureka Holly, Eureka County; the Nevada United, White Pine County; and the Bristol Silver, Lincoln County.

Mine production of lead in Nevada in 1920, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Churchill	36		12,623				12,659
Clark	221		915,009	2,560	91,389	3,009,685	4,018,864
Elko		2,562	3,350,602				3,353,164
Esmeralda	12,509		83,234				95,743
Eureka	248,627	809	2,237,774				2,487,210
Humboldt	2,090		20,744			5,200	28,034
Lander	7,000		255,045				262,045
Lincoln	5,485,199	1,500	1,311,056		1,106,715		7,904,470
Mineral	5,056		151,675		1,824		158,555
Nye	2,587		630,640				633,227
Pershing	7,108		94,190				101,298
Washoe	873		84,299				85,172
White Pine	17,819		1,965,082		140,358		2,123,259
	[a] 5,789,125	4,871	11,111,973	2,560	1,340,286	3,014,885	21,263,700

[a] Includes 213,205 pounds from gold ore, 30,857 pounds from gold and silver ore, and 5,545,063 pounds from silver ore.

ZINC.

The mine production of zinc increased nearly 19 per cent in 1920. Clark County made the largest part of the output, all of it from the Yellow Pine district, and was followed in order by Ely, in White Pine County, and the Gold Run district, in Humboldt County.

More than 97 per cent of the zinc was obtained from ores produced at three mines—the Yellow Pine and Goodsprings Mining Co., in Clark County; and the Consolidated Coppermines Co., at Ely, in White Pine County.

Mine production of recoverable zinc in Nevada in 1920, in pounds.

County.	Zinc ore.	Lead-zinc ore.	Total.
Clark	752,040	8,629,463	9,381,503
Humboldt		1,700	1,700
White Pine	1,314,837		1,314,837
	2,066,877	8,631,163	10,698,040

Zinc-producing ores and concentrates from Nevada mines sold in 1920.

Classification.	County.	Quantity.	Average zinc assay of ore and concentrate.[a]
		Short tons.	*Per cent.*
Oxidized zinc ore	Clark and White Pine	2,898	41.95
Oxidized lead-zinc ore	Clark	1,090	25.67
Zinc concentrates	Clark and Humboldt	11,993	40.00
		15,981	39.38

[a] Actual assay content.

MINING INDUSTRY IN NEVADA.

The unfavorable operating conditions of 1919 continued throughout 1920. Operating costs were higher because of the increased cost of labor and supplies. The scarcity of labor prevailed until near the end of the year. At Virginia City labor troubles interfered, but to a less extent than in 1919. Mining operations at Tonopah were interrupted by labor demands in February and again in April. In settlement of the February interruption the mine operators granted a wage increase of 50 cents a day to all classes of labor, owing to the high cost of living in Tonopah. There was considerable activity in prospecting and in seeking promising properties, and merchants recorded more inquiries for mining machinery. The only smelter operating was the Nevada Consolidated, at McGill. The Mason Valley smelter, at Thompson, was idle.

About 631 pounds of quicksilver was purchased for amalgamation mills. At cyanide mills 1,672,190 pounds of sodium cyanide was used.

Gold and silver produced from Nevada mills in 1920.

County.	Ore.	Bullion recovered from ore by—				Total value.
		Amalgamation.		Cyanidation.		
		Gold.	Silver.	Gold.	Silver.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	
Churchill	1,208			514.64	14,154	$26,067
Clark	[a]9,260	214.00	236	[b]2,070.68	[b]52,619	104,841
Elko	55,632	19.45	16	20,940.37	118,975	562,978
Esmeralda	[c]21,448	1,294.32	543	[d]5,132.21	[d]265,059	422,354
Eureka	60	42.33	6			882
Humboldt	309	176.18	46	20.02	370	4,509
Lander	475	23.51	5		5,591	6,586
Lyon	18,638	420.03	348	[e]3,868.82	[e]88,706	185,727
Mineral	7,070	772.27	867	[f]2,603.18	[f]3,747	74,806
Nye	[g]420,354	13,041.62	9,252	51,307.36	4,787,607	6,558,787
Pershing	74,673	453.90	301	[h]5,895.61	[h]583,677	767,792
Storey	39,191	836.82	812	[i]14,684.97	[i]323,081	673,907
Washoe	295	294.72	116	41.43	205	7,299
White Pine	258	21.87	6	2.00	3,533	4,351
	648,871	17,611.02	12,554	107,081.29	6,247,324	9,400,886

[a] Also yielded 22 tons of concentrates.
[b] Includes bullion from 1,575 tons of old tailings.
[c] Also yielded 17 tons of concentrates.
[d] Includes bullion from 300 tons of old tailings.
[e] Includes bullion from 11,600 tons of old tailings.
[f] Includes bullion from 130 tons of old tailings.
[g] Also yielded 153 tons of concentrates.
[h] Includes bullion from 615 tons of old tailings.
[i] Includes bullion from 19,300 tons of old tailings.

Mills equipped for the concentration of low-grade ore treated more than 75 per cent of the total ore sold or treated. The average value of the concentrates per ton was $28.83.

Mine production of gold, silver, copper, lead, and zinc from Nevada concentrates in 1920.

By counties.

County.	Ore to concentrating mills.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clark	14,947	13,977	779.00	117,509	1,133	2,748,979	8,153,880	$1,024,779
Esmeralda	1,342	146	148.57	10,604	142	44,694	.....	18,230
Humboldt	22	9	.43	312	.....	5,200	1,700	903
Lander	1,666	98	30.00	4,054	.....	23,532	.....	6,922
Lincoln	60	10	2.46	388	.....	6,594	.....	1,001
Lyon	25,878	2,042	.....	3,970	991,013	.....	.....	186,673
Nye	6,985	869	546.71	75,011	347	319,357	.....	118,677
Pershing	1,005	97	4.95	15,984	605	.....	.....	17,636
Washoe	810	81	1.97	9,578	936	44,651	.....	14,225
White Pine	2,569,338	349,778	22,578.76	63,667	47,058,014	4,436	.....	9,195,171
	2,622,053	367,107	24,092.85	301,077	48,052,190	3,197,443	8,155,580	10,584,217

By kinds of concentrates.

Dry or siliceous	301	1,263.82	99,973	711	7,835	.....	$135,853
Copper	351,802	22,522.76	65,529	48,048,849	.....	.....	9,378,002
Lead	2,998	260.27	135,440	1,497	2,558,645	.....	357,976
Zinc	11,993	.....	.....	.....	629,000	8,155,580	710,922
Copper-lead	13	46.00	135	1,133	1,963	.....	1,464

Average content.

Kind of concentrates.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	301	4.20	332.14	0.12	1.30	.....	$451.34
Copper	351,802	.06	.19	6.83	.....	.....	26.66
Lead	2,998	.09	45.18	.02	42.67	.....	119.40
Zinc	11,993	.....	.....	.....	2.62	34.00	59.28
Copper-lead	13	3.54	10.38	4.36	7.55	.....	112.62
	367,107	.07	.82	6.54	.44	1.11	28.83

All the higher-grade ores were shipped to the smelters, the siliceous ores in greatest quantity and the lead ores in greatest value.

Mine production of gold, silver, copper, lead, and zinc from Nevada crude ore shipped to smelters in 1920.

By counties.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Churchill	84	19.92	12,532	.....	12,659	.....	$15,085
Clark	4,120	2,807.01	16,581	120,375	1,269,885	1,227,623	299,276
Elko	9,128	31.65	200,513	147,699	3,353,164	.....	514,643
Esmeralda	1,208	4,019.41	12,676	13,820	51,049	.....	103,532
Eureka	4,984	2,235.23	74,238	14,770	2,274,830	.....	311,829
Humboldt	252	1,121.66	13,369	8,801	22,834	.....	41,205
Lander	1,589	298.03	50,368	92,077	238,513	.....	97,085
Lincoln	117,594	1,198.84	567,290	553,186	7,897,876	.....	1,376,744
Lyon	194	.91	535	48,431	.....	.....	9,513
Mineral	1,249	905.52	54,407	70,886	158,555	.....	103,750
Nye	2,329	1,909.12	29,742	1,238	313,870	.....	97,222
Pershing	1,060	507.15	42,099	2,279	101,298	.....	64,895
Storey	3	54.08	851	.....	.....	.....	2,046
Washoe	236	45.16	10,534	5,928	40,521	.....	16,748
White Pine	27,543	369.14	72,597	1,313,666	2,060,595	1,314,837	599,826
	171,573	15,522.83	1,158,332	2,393,156	17,795,649	2,542,460	3,653,399

By kinds of ore.

Dry or siliceous	110,708	9,249.66	557,499	60,697	5,566,464	.....	$1,255,366
Copper	21,421	401.41	17,448	1,802,771	4,871	.....	359,415
Lead	29,577	2,981.34	469,162	156,076	10,583,246	.....	1,448,395
Zinc	2,898	.....	.....	.....	2,560	2,066,877	167,622
Copper-lead	5,879	2,890.42	114,223	373,612	1,338,323	.....	360,064
Lead-zinc	1,090	.....	.....	.....	300,185	475,583	62,537

Average content.

Kind of ore.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	110,708	0.08	5.04	0.03	2.51	.....	$11.34
Copper:							
Oxidized	21,052	.01	.80	4.11	.01	.....	16.30
Sulphide	369	.27	1.52	9.97	.....	.....	43.97
Lead:							
Oxidized	20,213	.11	16.70	.07	20.03	.....	52.80
Sulphide	9,364	.08	14.06	.69	13.28	.....	40.71
Zinc:							
Oxidized	2,898	.....	.....	.....	.04	35.66	57.84
Copper-lead:							
Oxidized	5,879	.49	19.43	3.18	11.38	.....	61.25
Lead-zinc:							
Oxidized	1,090	.....	.....	.....	13.77	21.82	57.37
	171,573	.09	6.75	.70	5.19	.74	21.29

PRODUCTION BY COUNTIES.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1920.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total value.	Quantity.	Value.
	Quantity.	Value.	Quantity.	Value.			
	Fine ounces.		*Fine ounces.*			*Fine ounces.*	
Churchill	.....	.....	534.54	$11,050	$11,050	26,686	$29,088
Clark	.....	.....	5,870.69	121,358	121,358	186,945	203,770
Elko	6.19	$128	20,991.46	433,932	434,060	319,504	348,259
Esmeralda	22.35	462	10,594.51	219,008	219,470	288,885	314,885
Eureka	14.13	292	3,070.26	63,468	63,760	84,006	91,566
Humboldt	26.03	538	1,318.26	27,251	27,789	14,102	15,371
Lander	1,190.89	24,618	351.55	7,267	31,885	60,194	65,611
Lincoln	.....	.....	1,201.30	24,833	24,833	567,678	618,769
Lyon	1,314.30	27,169	4,289.75	88,677	115,846	94,285	102,771
Mineral	.....	.....	4,280.99	88,496	88,496	59,021	64,333
Nye	4,769.82	98,601	66,804.81	1,380,978	1,479,579	4,903,987	5,345,346
Pershing	3.43	71	6,916.76	142,982	143,053	653,669	712,499
Storey	.....	.....	15,575.88	321,982	321,982	324,744	353,971
Washoe	.....	.....	383.28	7,923	7,923	20,433	22,272
White Pine	36.77	760	22,972.51	474,884	475,644	140,954	153,640
	7,383.91	152,639	165,156.55	3,414,089	3,566,728	7,745,093	8,442,151

County.	Copper.		Lead.		Recoverable zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Churchill	.....	.....	12,659	$1,013	.....	.....	$41,151
Clark	121,508	$22,357	4,018,864	321,509	9,381,503	$759,902	1,428,896
Elko	147,699	27,177	3,353,164	268,253	.....	.....	1,077,749
Esmeralda	13,962	2,569	95,743	7,659	.....	.....	544,583
Eureka	121,029	22,269	2,487,210	198,977	.....	.....	376,572
Humboldt	8,801	1,619	28,034	2,243	1,700	137	47,159
Lander	92,077	16,942	262,045	20,963	.....	.....	135,401
Lincoln	553,186	101,786	7,904,470	632,358	.....	.....	1,377,746
Lyon	1,045,944	192,454	.....	.....	.....	.....	411,071
Mineral	70,886	13,043	158,555	12,684	.....	.....	178,556
Nye	1,585	292	633,227	50,658	.....	.....	6,875,875
Pershing	3,751	690	101,298	8,104	.....	.....	864,346
Storey	.....	.....	.....	.....	.....	.....	675,953
Washoe	6,864	1,263	85,172	6,814	.....	.....	38,272
White Pine	48,372,471	8,900,535	2,123,259	169,861	1,314,837	106,502	9,806,182
	50,559,763	9,302,996	21,263,700	1,701,096	10,698,040	866,541	23,879,512

Production from deep mines in Nevada in 1919 and 1920.

County.	Ore sold or treated.		Number of deep mines producing.		Average value per ton.[a]		Average value per ton in gold and silver.[a]	
	1920	Increase or decrease.	1919	1920	1919	1920	1919	1920
	Short tons.	*Short tons.*						
Churchill	1,292	− 39,600	12	9	$16.34	$31.85	$16.31	$31.07
Clark	29,902	− 10,253	40	34	27.98	47.79	10.82	10.87
Elko	64,760	+ 4,749	27	35	16.62	16.64	15.66	12.08
Esmeralda	24,298	− 4,185	20	43	40.15	22.39	39.17	21.97
Eureka	8,970	+ 5,542	18	23	49.60	41.95	29.15	17.28
Humboldt	583	+ 365	13	17	136.49	79.96	121.71	73.10
Lander	3,730	− 1,133	25	22	36.81	29.65	21.97	19.49
Lincoln	117,654	+ 20,979	17	23	9.73	11.71	5.58	5.47
Lyon	56,660	− 53,238	23	21	6.56	6.76	1.36	3.36
Mineral	8,449	− 10,480	37	43	18.13	21.13	15.04	18.09
Nye	429,668	+ 88,900	50	53	16.20	15.77	16.18	15.65
Ormsby	.....	− 104	2	.....	21.93	.....	21.93	.....
Pershing	77,583	− 37,783	40	40	8.45	11.14	8.14	11.03
Storey	58,494	+ 8,118	21	20	15.86	11.56	15.86	11.56
Washoe	1,341	+ 1,104	11	15	44.78	28.54	42.66	22.52
White Pine	2,597,236	+319,808	28	36	4.25	3.77	.21	.24
	3,480,620	+292,789	384	434	7.31	6.82	3.79	3.41

[a] Value per ton, placer product excluded.

Production from placer mines in Nevada in 1919 and 1920.

County.	1919						1920					
	Mines.			Gold.	Silver.	Total. value.	Mines.			Gold.	Silver.	Total. value.
	Hydraulic.	Drift.	Dredge.				Hydraulic.	Drift.	Dredge.			
					Fine ounces.						*Fine ounces.*	
Elko	1	.....	.....	$41	.....	$41	3	.....	.....	$128	.....	$128
Esmeralda	.....	.....	.....	.....	.....	.....	2	.....	.....	462	3	465
Eureka	2	.....	.....	570	2	572	2	.....	.....	292	1	293
Humboldt	1	.....	.....	896	8	905	1	.....	.....	538	5	544
Lander	7	1	.....	49,183	319	49,540	3	2	.....	24,618	176	24,810
Lyon	1	.....	.....	663	4	668	.....	.....	1	27,169	726	27,960
Mineral	5	.....	.....	937	28	968	.....	.....	.....	.....	.....	.....
Nye	9	7	.....	78,644	1,999	80,883	[a] 18	4	.....	98,601	2,375	101,190
Pershing	2	.....	.....	945	9	955	1	.....	.....	71	1	72
White Pine	1	.....	.....	409	5	415	2	.....	.....	760	9	770
	29	8	.....	132,288	2,374	134,947	32	6	1	152,639	3,296	156,232

[a] Part of operations drifting and sluicing.

CHURCHILL COUNTY.

Alpine district.—A lessee on the Nevada Wilson property made a small shipment of silver ore taken out during development work.

Fairview district.—No development work was reported in the Fairview district, but a small quantity of silver ore containing gold was cleaned up from the old workings of one of the mines.

Silver Range district.—The Silver Ace, an abandoned property, yielded a few tons of ore containing some silver.

Wonder district.—Ore from some of the old workings of the Nevada Wonder property and shipments from three other mining claims had a total value of $26,512.

Broken Hills district.—The Cracker Jack and Broken Hills property, operated by the Ridge Silver Mines Corporation, produced one lot of silver ore, carrying some lead and gold. Considerable development work on the mining claims was reported.

CLARK COUNTY.

Mine production in Clark County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	40	40,155	$145,043	258,288	148,469	4,257,114	5,974,219	$1,123,686
1920	34	29,902	121,358	186,945	121,508	4,018,864	9,381,503	1,428,896
Increase or decrease, 1920	−6	−10,253	−23,685	−71,343	−26,961	−238,250	+3,407,284	+305,210

Eldorado Canyon district.—Three mine operators in the Eldorado Canyon reported the output of 9,160 tons of ore, the bulk of which was treated in milling plants and produced gold and silver bullion and a small quantity of concentrate containing gold and silver. Twenty tons of first-class ore, containing silver was shipped to a smelter. The producers were the Techatticup, Rand, and Oro Plata properties.

Searchlight district.—The output of seven producers in the Searchlight district amounted to 2,131 tons of ore and old tailings. Ore shipped amounted to 521 tons, containing 2,786 ounces of gold, 3,981 ounces of silver, 43,808 pounds of copper, and 89,473 pounds of lead. Gold and silver bullion was recovered from 120 tons of ore treated at gold and silver mills, and 390 tons of ore was concentrated, producing a copper-lead concentrate containing much gold. The Duplex and Big Casino were the largest producers of ore, and some old tailings was treated at the Cyrus Noble mill by a lessee. Other mines producing were the Peerless and Quartette, the output coming from former operations.

Yellow Pine district.—Twenty-four mine operators in the Yellow Pine district produced 18,611 tons of ore in 1920. Of this output, 14,557 tons was concentrated, most of which was treated in a milling plant making a separation of lead and zinc concentrates, and 3,579 tons was shipped directly to lead and zinc smelters. Some gold bullion was recovered at one milling plant. From the Yellow Pine mine about 15,000 tons of ore was mined, part of which was milled and part shipped directly to lead and zinc smelters. The Yellow Pine Mining Co., in cooperation with the United States Bureau of Mines, constructed testing works at Goodsprings and investigated the process [2] for the volatilization of lead and zinc as chloride from zinc carbonate concentrates.

Considerable lead-zinc ore was shipped from the Goodsprings, Bullion, and Potosi mines. Some of the tailings from the Keystone mill was treated in cyanide tanks by percolation. Shipments of ore

[2] Chloride volatilization process: Min. and Sci. Press, vol. 123, p. 159, July 30, 1921.

were also reported from the Boss, Azurite, Coppersides, Dawn, Ingomar, Kirby, Red Streak, Singer, Christmas Consolidated, Sultan, and Tiffany properties.

ELKO COUNTY.

Mine production in Elko County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	28	60,011	$704,256	201,336	122,520	849,021	$997,539
1920	38	64,760	434,060	319,504	147,699	3,353,164	1,077,749
Increase or decrease, 1920	+10	+4,749	−270,196	+118,168	+25,179	+2,504,143	+80,210

[a] Includes placer production.

Contact or Salmon River district.—About 6 carloads of crude ore was shipped to a copper smelter from the Delano mine. The property is opened by a 300-foot shaft and an adit 500 feet long.

Delno district.—Considerable activity in the Delno district was shown by shipments of ore from seven mines, the largest part of the output coming from the Net property, of the Delno Mining Co. Altogether 1,203 tons of ore was shipped from the district, containing $43 in gold, 38,930 ounces of silver, 2,639 pounds of copper, and 583,068 pounds of lead, valued in all at $89,607, or $74.49 a ton.

Dolly Varden district.—The Mud Springs property yielded a small lot of lead ore containing silver.

Gold Circle district (Midas).—The Elko Prince and four small producers in the Gold Circle district reported an output of more than 14,000 tons of ore, containing gold and silver. All the ore was milled in the district and produced bullion, principally by cyanidation.

Jarbidge district.—The Elkoro Mines Co. was the largest producer of gold bullion in the State in 1920, though a larger output of gold resulted from the treatment of copper bullion from Ely. Ore from the Long Hike and Starlight mines, of the Elkoro Co., was treated by cyanidation. The property is opened by a 1,000-foot adit and several drifts aggregating 6,000 feet. Considerable development work was carried on, and the 100-ton cyanide plant was operated the entire year, with only a few interruptions caused by power troubles and relining ball mills.

Lone Mountain district.—A small quantity of lead ore, containing silver, was shipped to the smelter from the Rip Van Winkle property.

Railroad district.—Seven producers in the Railroad district reported the output of 197 tons of ore, all of shipping grade, containing $104 in gold, 2,183 ounces of silver, 31,026 pounds of copper, and 12,398 pounds of lead, valued in all at $9,184, or $46.62 a ton. The Bunker Hill, Gray Eagle, Kentucky, Sweepstake, and Copper Bell properties were the principal producers.

Spruce Mountain district.—The Spruce Monarch Mining Co., the largest producer in the Spruce Mountain district, shipped more than 7,000 tons of silver-lead ore. Smaller quantities of ore were shipped from the Bullshead, Black Forest, and Index properties.

Tecoma district.—A small lot of lead ore was shipped from the Jackson mine.

Tuscarora district.—Several small lots of bullion were shipped from pannings in the Tuscarora district and some silver ore from the Original-Nevada property.

ESMERALDA COUNTY.

Mine production in Esmeralda County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	20	28,483	$787,579	292,928	128,278	79,294	$1,143,721
1920	45	24,298	[a] 219,470	[a] 288,885	13,962	95,743	544,583
Increase or decrease, 1920	+25	−4,185	−568,109	−4,043	−114,316	+16,449	−599,138

[a] Includes placer production.

Columbus district.—Two small lots of ore were reported as having been produced from the Columbus district in 1920. Several famous mines are at Candelaria, just over the line in Mineral County.

Desert district.—The Carrie Silver and Black Mammoth mines produced some shipping ore containing silver during a short period of development.

Goldfield district.—The production of the Goldfield district is shown below:

Mine production of Goldfield district, Nevada, 1904–1920.

Year.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	16,435	$740,265	39,912	125,418	1,460	$808,373
1920	6,571	[a] 155,789	[a] 6,081	13,440	.....	164,890
Decrease, 1920	9,864	584,476	33,831	111,978	1,460	643,483
Total, 1904–1920	.....	82,360,803	1,343,266	7,552,563	27,540	84,658,672

[a] Includes placer production.

Operations at Goldfield were restricted by the difficulty in procuring capital. Fifteen producers shipped or treated 6,571 tons of ore. Most of the ore milled was taken from the Florence and Goldfield mines, each of which also produced some ore of shipping grade. The ore directly smelted amounted to 982 tons and contained 3,958.89 ounces of gold, 5,810 ounces of silver, and 13,400 pounds of copper. The district output averaged $25.02 a ton, against $49.19 in 1919. Other mines producing were the Nevada Eagle, Diamondfield Daisy, Goldfield Deep Mines, Jumbo Extension, and Reorganized Kewanas.

The Goldfield Development Co. leased the mine and mill of the Goldfield Consolidated Mines Co. during 1920. Considerable underground work was done, and the mill was repaired in preparation for treating low-grade ores on a large scale. Owing to high costs

and the low grade of the ore, the attempt at milling proved unprofitable. The mine reverted to the owners, who have since adopted the policy of leasing the mine in small blocks.

Gold Mountain (Divide) district.—Production of ore continued in the Divide district in 1920, principally from the Tonopah Divide mine. The Gold Zone and Belcher Extension properties each produced considerable ore, and smaller quantities were mined from the Victory Divide, Revert Divide, Mutual Divide, Hasbrouck, and Divide Extension properties. All but 17 of the 10,994 tons of ore mined was shipped to cyanidation plants at Tonopah. The district output contained $27,410 in gold, 244,309 ounces of silver, and 8,747 pounds of lead, valued in all at $294,407, or $26.78 a ton. In a recent report [3] Knopf describes the general geology of the Divide district and compares it with that of Tonopah.

Klondyke district.—Of the 730 tons of ore produced in the Klondyke district all but 20 tons was milled at cyanidation plants at Tonopah. The producers of ore were the Knox Divide and Original Klondyke mines.

Lida (Tule Canyon) district.—Three producers in the Lida district reported the output of 1,747 tons of ore, including 300 tons of old tailings re-treated. The metal output consisted of $328 in gold, 17,811 ounces of silver, and 78,673 pounds of lead, which, with 142 pounds of copper, was valued at $26,062, or $14.92 a ton. Most of the ore and the old tailings was the output of the Ingalls mine, operated by the Silver Hills-Nevada Mines Co. The company has an 8-stamp mill equipped with two Wilfley tables and sand tanks for handling tailings, which are to be treated later by cyanidation. Some ore was also treated in the mill of the Bullion Consolidated and the Allied Mining Co.

Lone Mountain district.—Some lead ore, containing a little silver, was shipped from a prospect in the Lone Mountain district operated by lessees.

Montezuma district.—Considerable development work was done in the Montezuma district, especially by the Montezuma Silver Corporation on the Arizona claim. Up to September 1, 1920, an inclined shaft 400 feet deep had been sunk and some repairs made on the vertical shaft. During the development work a small quantity of lead ore containing silver was shipped. Ore was also shipped from two other properties.

Silverpeak district.—Of the 4,186 tons of ore estimated to have been produced in the Silverpeak district, the larger part came from the Mary mine, which was operated by lessees. The ore, which was of milling grade and contained much silver and gold, was treated in the old cyanidation mill on the property.

[3] Knopf, Adolph, The Divide silver district, Nev.: U. S. Geol. Survey Bull. 715, pp. 147–170, 1921.

EUREKA COUNTY.

Mine production in Eureka County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	20	3,428	$22,621	69,523	40,713	1,179,723	$170,585
1920	25	8,970	63,760	84,006	121,029	2,487,210	376,572
Increase, 1920	5	5,542	41,139	14,483	80,316	1,307,487	205,987

[a] Includes placer production.

Cortez district.—Lead ore, containing silver and a little gold, was reported by three producers in the Cortez district. The value of 85 tons shipped was $8,339, or $98.11 a ton.

Eureka district.—Nine producers in the Eureka district reported the production of 8,825 tons of ore and speiss from old smelter operations, all of which was shipped directly to the smelters. The district output contained $62,385 in gold, 78,878 ounces of silver, 120,268 pounds of copper, and 2,457,094 pounds of lead, valued in all at $367,059, or $41.59 a ton. Speiss formed the largest part of the output. Considerable ore was shipped from the Holly, Croesus, and Eureka Consolidated mines. Lessees on other properties shipped smaller lots of ore.

The Richmond-Eureka property [4] was operated entirely by lessees, who shipped 1,034 tons of low-grade silver-lead ore and 3,941 tons of speiss to the smelter at Midvale, Utah. The old smelter slag dumps are variously estimated to contain from 50,000 to 100,000 tons of speiss. The continuation of its treatment in quantity depends solely upon the demand for white arsenic.

Lynn district.—Some gold bullion was shipped from ore treated at the Lynn Big Six mill. The property was under development, and experiments were being made to treat the ore by a new process.

HUMBOLDT COUNTY.

Golconda district.—The Oro Belle property produced some silver ore.

Gold Run (Adelaide) district.—Six producers in the Gold Run district reported the output of 123 tons of ore, containing $436 in gold, 1,788 ounces of silver, 6,315 pounds of copper, 14,064 pounds of lead, and 1,700 pounds of recoverable zinc, valued in all at $4,809, or $39.10 a ton. All the ore was shipped in small lots, mostly for testing, and came from the Caroline, Blue Bird, and St. Valentine claims. One lot of ore containing zinc was shipped to Midvale, Utah, for concentration.

Jackson Creek district.—One small lot of lead ore, containing silver, was shipped from the Weber & Hanson prospect.

National district.—The output of the National and Buckskin properties consisted of a few tons of rich gold ore shipped directly to the smelter.

[4] United States Smelting, Refining & Mining Co. Fifteenth Ann. Rept., for year ending Dec. 31, 1920.

Warm Springs district.—From the Ashdown property more than 200 tons of ore was estimated to have been mined and treated by amalgamation. Gold bullion was shipped to the San Francisco Mint.

Winnemucca Mountain district.—Five mines in the Winnemucca Mountain district produced 64 tons of ore valued at $5,244, or an average of $81.94 a ton. Most of it was first-class silver ore smelted, but a little gold and silver bullion was recovered from ore milled.

Iron Point (unorganized district).—Several lots of silver ore, containing a little lead and gold, were mined and shipped to the smelter from the Silver Coin property, 3 miles south of Iron Point, on the Southern Pacific Railroad.

LANDER COUNTY.

Battle Mountain district.—Five producers in the Battle Mountain district reported the output of 2,678 tons of ore, containing $3,605 in gold, 14,875 ounces of silver, 90,135 pounds of copper, and 226,297 pounds of lead, valued in all at $54,508, or $20.35 a ton. Most of the ore produced was milled and yielded lead concentrate, containing silver, and 987 tons was shipped directly to the smelters. Although the Copper Canyon property was closed a few shipments of copper ore were made from this property, probably from the operations of 1919. Some lead ore was mined and shipped from the Marion group.

Placer mining, most of which was done by drifting and sluicing, was carried on near the mouth of Copper Canyon, and five producers reported an output of $24,618 in gold and 176 ounces of silver. The Dahl placers and the newly organized Homestake Consolidated Placer Mines Co. were the largest producers. According to one of the placer operators,[5] the Homestake placers extend along Copper Canyon for 2,400 feet. There is no water flowing in the canyon, and its scarcity is the greatest drawback to extensive operations. The bedrock is smooth and covered with 40 to 50 feet of gravel containing few boulders. The gold is found over an average width of 125 feet and the material is said to average 75 cents a cubic yard from the sand to 3 feet above the bedrock.

Bullion district.—Lessees on the Maysville and other properties in the Bullion district shipped 157 tons of ore, containing principally silver with a little gold, copper, and lead, valued at $15,224, or an average of $96.97 a ton.

Cortez district.—The Cortez district extends into Eureka County, but the two properties in Lander County produced 55 tons of ore. The ore contained principally lead with some silver and gold and was valued at $4,569.

Hilltop district.—The Gray Eagle, Pittsburg-Red Top, and one other property in the Hilltop district produced 248 tons of ore valued at $17,981, or $72.50 a ton.

Kingston district.—Some silver ore from the Kingston property was treated by cyanidation in 1920.

Reese River district.—Five small lots of ore were shipped from the Reese River district in 1920, most of it from the Dakota and Austin-Manhattan properties. The total output of 120 tons, valued at $10,616, was largely silver ore.

[5] Personal communication from G. B. Thatcher, Reno, Nev., June, 1920.

LINCOLN COUNTY.

Mine production of Lincoln County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	17	96,675	$27,493	457,152	115,539	7,051,388	78,200	$940,426
1920	23	117,654	24,833	567,678	553,186	7,904,470	.....	1,377,746
Increase or decrease, 1920	+6	+20,979	−2,660	+110,526	+437,647	+853,082	−78,200	+437,320

Atlanta district.—A small quantity of ore, containing silver, was shipped from the Miner's Delight property.

Comet district.—Three producers in the Comet district reported the shipment of 188 tons of ore, containing $409 in gold, 7,721 ounces of silver, a little copper, and 26,745 pounds of lead, valued in all at $11,036, or $58.70 a ton. The producers were the New Lyndon, Stella, and Tungsten Comet properties.

Ferguson (Delamar) district.—Some silver ore from the Magnolia mine was shipped to the smelter as a test.

Highland Valley district.—The Last Chance claim produced a small quantity of lead ore containing silver and gold.

Jack Rabbit district.—Five producers in the Jack Rabbit district reported the output of 15,527 tons of ore of shipping grade, containing $4,303 in gold, 222,160 ounces of silver, 429,029 pounds of copper, and 1,254,647 pounds of lead, valued in all at $425,770 or $27.42 a ton. The companies operating and shipping most of the ore were the Black Metals, Bristol Silver, and E. & F.

The Black Metals mine produced 18,000 tons of ore suitable for fluxing, for which the smelter paid $111,000. The mine is developed to the 900-foot level. On the 325-foot level 54 tons of ore mined netted the company $17,000. Some of the ore contained as high as 1,500 ounces of silver to the ton, and the first carload of 27 tons averaged 285 ounces to the ton and 27 per cent of lead and some copper and gold. The cost of mining is reported to be $4.15 a ton.

An aerial tramway 8,400 feet long over the mountain connects the Bristol Silver mines with the ore bins on the Pioche-Pacific Railroad. By a new arrangement the 900-foot level of the Black Metals property will be extended into Bristol Silver territory and thus provide a direct connection with the railroad ore bins.

Pahranagat district (Hiko).—Two small lots of lead ore, containing silver and a little copper, were shipped from the Silver Prince and one other property in Pahranagat district.

Patterson district.—One lot of siliceous silver ore was shipped to the smelter from the property of the Lake Valley Mining Co.

Pioche district.—Nine producers in the Pioche district reported 101,778 tons of ore, containing $20,005 in gold, 333,382 ounces of silver, 122,610 pounds of copper, and 6,614,311 pounds of lead, valued in all at $935,096, or $9.19 a ton. All the ore except 60 tons of milling grade which produced some lead concentrate was shipped to the smelter. The Prince Consolidated property was the

largest producer, followed by its neighbor, the Virginia Louise, and the Combined Metals and the lessees operating the Amalgamated Pioche mines. Other producers were the Volcano, Mendha, and Hamburg.

LYON COUNTY.

Mine production in Lyon County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	
1919	24	109,898	$79,367	62,860	3,076,647	$722,026
1920	22	56,660	115,846	94,285	1,045,944	411,071
Increase or decrease, 1920	−2	−53,238	+36,479	+31,425	−2,030,703	−310,955

[a] Includes placer production.

Silver City (Palmyra) district (Dayton and Como).—Twelve producers of ore in the Silver City district and one reporting some bullion from placer operations had an output valued at $213,295. All the ore (18,626 tons) was milled by amalgamation, producing gold and silver bullion. Tailings estimated at 11,400 tons were re-treated by cyanidation. The bullion from milling plants contained 4,270.03 ounces of gold and 89,051 ounces of silver. Most of the output of the district was that of the Como Consolidated Mining Co., and part of it was from the re-treatment of tailings at Dayton and Silver City. The Oest and Well Emma were small producers of ore. The ore from the mines about Silver City is of high grade, when considered as a milling product, and ranges from $5 to $50 a ton, principally in gold. It is free milling, and 85 per cent of the assay value can be recovered by amalgamation.

There are three small mills at Silver City. The McTigue mill is equipped with stamps and plates; the Donovan mill is a cyaniding leaching plant, which treats tailing. Lessees and small producers of ore use the McTigue mill and pay for its use at the rate of $2.50 a ton of ore treated. The owner of the ore cleans the batteries and plates of amalgam, selling the tailing to the Donovan cyanide plant, only a short distance below the McTigue mill. The tailing, if sold, is diverted to a sluice; otherwise it follows the creek channel, and some of it is reclaimed. When the tailing is sold to Donovan, the owner is paid for 60 per cent of its value less $2.50 a ton for treatment. Tailing containing considerable slime is sun dried, and a disk plow mixes the coarser sand with the fine, thus making a product easy to percolate.

The Gold Canyon Dredging Co. completed its dredging plant, which has a capacity of 5,000 cubic yards a day, and began operations on September 5. The dredge was floated 2 miles below Silver City with water piped to the ground by the Virginia & Gold Hill Water Co. The proved placer area controlled by the dredging company is estimated to contain 8,000,000 yards of gravel in 700 acres, of which approximately 200 acres has been tested by shaft and drill holes. Bedrock is from 15 to 40 feet deep.

Yerington district.—Of the nine producers in the Yerington district the Bluestone property had the largest output; most of it was milling ore, which produced copper concentrate containing a little silver. The Walker River Co. at Yerington did experimental work at its leaching plant and shipped some copper precipitates. Other producers were the Ouija, Snowstorm, and Jumbo mines, and several properties produced small lots through lessees.

MINERAL COUNTY.

Mine production in Mineral County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	42	18,929	[a] $191,219	[a] 84,240	296,815	65,204	$344,232
1920	43	8,449	88,496	59,021	70,886	158,555	178,556
Increase or decrease, 1920	+1	−10,480	−102,723	−25,219	−225,929	+93,351	−165,676

[a] Includes placer production.

Bell district (Mina, Omco).—Among the five producers in the Bell district those who made the largest output were the Olympic and the Simon Silver-Lead mines. Much gold ore was treated by cyanidation at the Olympic mine, and several lots of lead ore were shipped by the Simon Silver-Lead Co. east of Mina, which is reported to have developed more than 500,000 tons of ore and extended operation to the seventh level, 565 feet deep. The district output in 1920 amounted to 6,782 tons of ore valued at $64,903, or an average of $9.57 a ton.

Buena Vista district.—Some silver ore from the Friday claim was treated by cyanidation.

Columbus district.—The Candelaria Mines Co. stopped development in November after having done about 6,000 feet of work. It is reported that more than 60,000 tons of ore, containing 15 ounces of silver and $1 in gold to the ton has been blocked out. The company has made arrangements for a milling plant, which will probably be completed in 1921.

Garfield district.—The Silversides, Mabel, Just Rite, and a neighboring prospect produced 83 tons of lead-silver ore valued at $7,265.

Gold Range district.—The New Hope claim produced a small quantity of silver ore containing considerable gold.

Hawthorne district.—From the Gold Bug and Wilson mines 256 tons of ore, containing principally gold, was estimated to have been produced.

Holy Cross district.—The Mineva claim, with a shaft 95 feet deep, produced one lot of copper ore containing silver.

Rand district.—The Nevada-Rand, Gold Pen, and one other property produced gold and silver ore. The Gold Pen operated its Kincaid mill until September 15, when both the mine and the mill were closed. One small lot of ore was shipped to the smelter from the Nevada-Rand mine during exploration of the 200-foot level. The

ore was siliceous and contained sulphide and chloride of silver occurring in highly silicified andesite.

Rawhide district.—Lessees operating on the property of the Nevada New Mines and other operators in the Rawhide district mined 284 tons of ore, containing gold and silver, most of which was smelted.

Santa Fe district (Luning).—The output of five producers in the Santa Fe district amounted to 157 tons of ore, containing gold, silver, lead, and a little copper, valued at $3,831. All the ore except 44 tons which was cyanided was shipped to smelters.

Silver Star (Marietta and Black Mountain) district.—The output of the Silver Star district consisted of several lots of lead ore and a shipment of rich silver ore aggregating 118 tons, which had a value of $19,510, or an average of $165.34 a ton.

NYE COUNTY.

Mine production in Nye County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	66	340,768	$1,537,980	3,622,680	15,370	55,272	$5,601,170
1920	75	429,668	1,479,579	4,903,987	1,585	633,227	6,875,875
Increase or decrease, 1920	+9	+88,900	−58,401	+1,281,307	−13,785	+577,955	+1,274,705

[a] Includes placer production.

Arrowhead district.—From the property of the Arrowhead Mining Co. some silver ore containing gold taken out in development work was shipped to a Tonopah milling plant.

Barcelona district.—The Spanish Belt property yielded some silver ore containing a little gold.

Bellehellen district.—A small quantity of bullion was produced from ore milled at the Clifford property.

Bruner section.—The 50-ton cyanide mill built for the treatment of ore from the Paymaster property was operated a short time and produced a small quantity of gold bullion. The mill will probably be operated as a custom plant in the future.

Cactus Springs district.—A small lot of silver ore from the Cactus Nevada mine was milled as a test.

Fairplay district.—The Gold Crown and Lucky Jim claims, each of which produced silver ore containing gold, were reported under development.

Johnnie district.—Considerable interest in the Johnnie district was caused by the finding of gold-bearing eroded material that can be developed by drifting and treated by sluicing. From the operations of a milling plant in the district some gold bullion was shipped.

Mammoth district (Lodi).—The Illinois or Lodi property was under investigation, during which some lead concentrate containing silver and gold was shipped.

Manhattan district.—Twelve producers in the Manhattan district mined 17,475 tons of ore that was milled locally and produced gold

and silver bullion and 1,496 tons of shipping ore, which contained gold. The value of the district output was $123,041, of which $78,221 came from deep mines. The placer production of 21 operators increased, with an output of bullion valued at $43,854 in gold and 886 ounces of silver, compared with 14 producers in 1919 shipping bullion containing $32,663 in gold and 723 ounces of silver. Of the ore producers the Big Pine and Jumping Jack properties were the largest, followed by the White Caps and April Fool. Smaller lots of ore were produced from the Stray Dog, Maybe So, Union No. 9, and Mustang. Among the placers those producing considerable gold and silver were the Central City, Robust, Pedro & Erwin Fraction, China, Edith, Johnson & Swanson, Verde, September, Top Knob No. 2, and Bedrock.

The White Caps Mining Co. extended development, discontinued milling, and shipped 1,496 tons of ore to the Tacoma smelter. The ore contained 669,392 pounds of arsenic and $38,146 worth of gold. The main shaft was sunk to the 1,000-foot level, and a station was cut on the 800-foot level.

The Manhattan district was far less active in the summer of 1920 than in 1919, according to Ferguson,[5] who visited the district and furnished the following notes:

> At the time the district was visited the White Caps Co., the largest operator, had closed its mill and was engaged in development work only. Work on the 800-foot level in the eastern part of the mine developed the downward extension of the eastern ore body. The ore here differs from that mined on the 660-foot level in that realgar, which formed a large part of the ore on the upper level, was nearly lacking. Work was also being pushed vigorously in the western part of the mine, particularly on the 550-foot level. Shortly after the writer's visit a new ore body was encountered on this level, to the west of those previously worked.
>
> The other limestone mines were idle. The Manhattan Consolidated and Union Amalgamated continued pumping, however. Chase & Johnson expected to renew operations on the Mustang claim. Here the ore occurs in peculiar circular pipes in the limestone.
>
> The schist mines on Gold Hill were idle, with the exception of the Big Pine which continued exploratory work. The low average tenor of the ore combined with the high costs prevailing at the time prevented any important production.
>
> Very little placer mining is being undertaken. The rich ground in the upper part of the gulch is largely exhausted. The westward extension of the gulch under the wash of Smoky Valley undoubtedly contains gold which will be won in future years, but at present such work appears to be unprofitable. An area covered by older high level gravel on the Little Gray claim a short distance west of the town was being prospected and it is reported that the results were encouraging.
>
> An article on the "Limestone ores of Manhattan" was published in the Economic Geology for January, 1921. In this paper the general geology of the district is described briefly. The body of the article is, however, devoted to a description of the peculiar types of ore found in the belt of limestone extending from the White Caps mine to Mustang Hill. This includes the White Caps, Manhattan Consolidated, Union Amalgamated, April Fool, and Mustang mines.

Philadelphia or Belmont district.—A small quantity of silver-lead ore valued at $155 a ton was shipped from the Lizzie claim, and some silver bullion and concentrate from previous operations were shipped from the Monitor Belmont property.

Reveille district.—Three properties in the Reveille district shipped 36 tons of ore, containing principally silver.

Round Mountain district.—Five producers in the Round Mountain district reported the output of 13,813 tons of ore, containing gold and silver valued at $231,414, or an average of $16.75 a ton. The

[5] Ferguson, H. G., U. S. Geol. Survey, unpublished notes.

output of bullion from placer operations was valued at $56,370. The Fairview Round Mountain and Round Mountain Mining companies were the principal operators, and all the ore was milled and yielded gold bullion. Most of the placer production was from the Round Mountain property.

In 1920 the placer property of the Round Mountain Mining Co.[6] produced gold and silver bullion valued at $56,277.37. Altogether 64,665 yards of material was hydraulicked and averaged 87 cents a yard. From the treatment of 4,513 tons of ore from the deep mine, $21,377.96 in gold and silver was recovered, representing an extraction of 91 per cent. The average total value of the ore was $5.199 a ton, tailings contained 46.4 cents, and the recovery was $4.73 a ton.

San Antone district.—The property operated by the Hudson Mining Co. produced some silver ore, which was cyanided, and some lead ore, which was shipped to the smelter.

Silver Bow district.—Several hundred tons of ore was mined at the Blue Horse property, resulting in the shipment of gold bullion and concentrate. A 20-ton Gibson mill was active in 1920.

Tonopah district.—The production of the Tonopah district is given below:

Mine production of Tonopah district, Nevada, 1904–1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	14	268,658	$771,804	3,568,875	.....	.....	$4,768,944
1920	19	387,489	1,056,986	4,816,055	.....	.....	6,306,486
Increase, 1920	5	118,831	285,182	1,247,180	.....	.....	1,537,542
Total, 1904–1920	.....	5,941,063	28,089,267	128,281,263	12,113	214,523	110,627,070

The production of the Belmont mine [7] was 131,303 dry tons of ore, which was 66 per cent greater than in 1919. The total content of this ore was 13,744.32 ounces of gold and 1,296,388.77 ounces of silver, valued at $1,798,742.45, or an average of $13.699 a ton. The total cost of mining was $5.88 a ton, or 53 cents higher than in 1919. Milling costs, including labor, supplies, power, direct milling ($3.32), and indirect milling amounted to $3.43 a ton, which was 13.5 cents less than in 1919. Concerning the treatment of custom ores and concentrates the company's report says:

> Custom ores aggregating 27,331 dry tons, of a gross value of $721,532.52 were purchased and milled during the year, with a resultant profit of $34,744.38, or about $1.271 per ton. "Sweepings," chiefly from the Belmont slime ponds at Tonopah, were milled at the re-treatment plant, with a resultant profit of $5,654.41, or about $3.091 per ton. * * *
>
> During the year a plant for the treatment of concentrates on the ground as alternative to the shipment of this product to the smelter was installed, at a total cost of $3,300.38, and starting in August of 1920, continued operations throughout the balance of the year with most satisfactory results. * * *
>
> The process consists, briefly, in the agitation of the concentrates in strong cyanide solution with other reagents, sending the pregnant solutions to the mill precipitation department and returning the treated concentrates (tailings) to the tube mills of the main mill circuit for still further treatment.

[6] Round Mountain Mining Co. Ann. Rept. for year ending Dec. 31, 1920.
[7] Tonopah-Belmont Development Co. Eighteenth Ann. Rept., for year ending Dec. 31, 1920.

During the year 312,139 tons of concentrates were treated locally at a direct cost of $13.38 per ton of concentrates. The metal losses were $12.86 per ton and the bullion marketing costs were $6.05 per ton, making a total for costs and losses of $32.29 per ton, as compared with $52.95 per ton of concentrates for the tonnage shipped to the smelter during the year. The saving per ton of concentrates was $20.66 and the total saving on the tonnage treated was $6,448.79. At the time the plant was placed in operation an increase of $4 per ton in the smelter-treatment rate became effective and later in the year freight rates were increased, so that the treatment plant actually netted a higher saving than the above figures present. The recovery in the concentrate treatment, as shown by the tailings from the plant, was 96 per cent, but as these tailings are reground and again sent through the main mill circuit, there occurs some considerable further extraction.

From the Tonopah Mining Co.'s property [8] there was produced 56,587 dry tons of ore. All but 723 tons, treated at the Belmont mill, was treated at the company's mill at Millers, which was reopened and started crushing January 26, 1920. The ore treated averaged 0.142 ounce of gold and 13.21 ounces of silver a ton and had an average value of $16.93 a ton. The profit on this ore was $238,822.92, or $4.22 a ton. In addition to the ore from mines, 6,979 tons of dump ore was shipped to the mill and averaged 0.065 ounce of gold and 6.40 ounces of silver to the ton. The value was $7.83 a ton and a profit of $1.93 a ton was realized. Some custom ore was also treated at the Millers plant. The mining cost was $5.945 per ton of ore mined, compared with $6.37 in 1919. The average cost for milling was $4.077. In October $50,000 was paid in dividends, making a total of $14,925,000 paid to stockholders since 1905.

The Jim Butler mine [9] produced 12,615.8 dry tons of silver ore in 1920, which includes the output of lessees. The average value was $20.89 a ton and the total value $363,658.44. The total earnings from Tonopah operations were $38,921.32, including the results from the operations of a lease given to the West End Consolidated Mining Co., which has opened up the western part of the Jim Butler territory. All the ore was sold to the Tonopah Belmont custom mill.

From the Tonopah Extension mine [10] 89,022 dry tons of ore was mined and treated by cyanidation, yielding 1,150,962.95 ounces of silver and 11,324.40 ounces of gold, valued at $1,387,973.47, or $15.59 a ton. The metal loss in the tailing amounted to $1.23 a ton. Cost of mining, including all development work, which was extensive, amounted to $6.44 a ton; milling, $4.09; and marketing, 27 cents, or a total of $10.80 a ton. Depreciation was charged at 61 cents, and the net realization per ton was $3. Dividends for the fiscal year amounted to $258,542.48, which, added to the total since 1905, amounted to $2,684,526.55. The Victor shaft was deepened to 1,930 feet at the end of 1920. It is the deepest shaft in the Tonopah district. The McKane shaft was retimbered and is to be sunk from the 1,100 to the 1,540 foot level.

The West End mine was the third largest producer of the Tonopah district in 1920. A 200-ton cyanidation plant was operated throughout the year, and the ore treated increased from 33,140 tons in 1919 to more than 50,000 tons in 1920. Shipments of silver bullion from the West End ore were valued at more than $1,000,000. Much custom ore was also treated at the West End mill for the Halifax Tonopah, Jim Butler, Rescue Eula, and other properties in the vicinity.

[8] Tonopah Mining Co. Ann. Rept. for year ending Dec. 31, 1920.
[9] Jim Butler Tonopah Mining Co. Ann. Rept. for year ending Dec. 31, 1920.
[10] Tonopah Extension Mining Co. Ann. Rept. for year ending Mar. 31, 1921.

Other mines of the Tonopah district which produced more than 4,000 tons of ore each were the Montana Tonopah, MacNamara, Halifax, Tonopah Midway, and Rescue Eula. Smaller quantities came from the Cash Boy, New California-Tonopah, and North Star mines.

Tybo district.—The Tybo and Reveille mines of the Louisiana Consolidated Mining Co. produced a large quantity of lead ore, most of which was milled. First-class ore and concentrate were shipped to the smelter by way of Tonopah, and some ore was treated in a lead smelter on the property.

ORMSBY COUNTY.

Iron ore from the Brunswick mine was shipped to iron works in California in 1920.

PERSHING COUNTY.

Antelope district.—Lead ore containing principally silver from the Last Chance property was mined and shipped by the Majuba-Fresno Silver Co.

Arabia district.—A small quantity of lead-antimony ore containing silver was shipped directly to the smelter from the Montezuma property.

Loring district (Lovelocks).—Four producers in the Loring district reported the output of 90 tons of gold ore, part of which was treated in a milling plant and the remainder shipped directly to a smelter. The Sheepherder property was the largest producer in the district.

Rochester district.—Ten producers in the Rochester district reported the production of 75,048 tons of ore and some placer bullion. The total value of the metals recovered was $807,115. The ore, most of which was milled, contained 6,323.81 ounces of gold, 620,046 ounces of silver, 2,342 pounds of copper, and 460 pounds of lead, valued in all at $807,043, or an average of $10.75 a ton. Most of the ore was treated at the mills of the Rochester Silver Corporation and the Nevada Packard Co. by the cyanidation process. Lessees shipped considerable silver ore, containing some gold, from the Buck & Charley property.

During 1920 the Rochester Silver Corporation [11] treated at its cyanide mill 42,820 tons of ore, from which bullion was recovered containing 5,469.42 ounces of gold and 444,187 ounces of silver, valued at $595,350.63. Of the total ore milled, 2,842 tons was from operations of lessees and 220 tons was custom ore. The ore treated in the mill averaged 0.139 ounce of gold and 12.63 ounces of silver to the ton, and the recovery was 91.7 per cent of the gold and 82.1 per cent of the silver. The electric power for the district is supplied by the Nevada Valleys Power Co., which receives water for generating the power from the United States Reclamation Service at the Lahontan dam, near Fallon, Nev. Owing to a shortage of water for electric power, the Rochester mill operated only 287 days. Extensive development work was carried on in the mine to the 1,360-foot level. On January 1, 1921, it was estimated that sufficient ore was in reserve to last eight months at the current rate of production.

Rosebud district.—Small test lots of silver ore were shipped from two prospects in the Rosebud district.

[11] Rochester Silver Corporation Ann. Rept. for year ending Dec. 31, 1920.

Seven Troughs district.—Six small producers of ore in the Seven Troughs district reported an output containing gold and silver valued at $2,033.

Sierra (Sunshine and Dun Glen) district.—Nine producers in the Sierra district reported 101 tons of shipping ore, a small quantity of mill ore, and some old tailings re-treated. The total output contained gold, silver, lead, and a little copper, valued at $9,063, or an average of $64.74 a ton.

Unionville district.—The Rye Patch tailing dump, the Arizona mine, and the Treasury group, of the Unionville Mining Co., were the principal producers in the Unionville district. The output consisted of gold and silver bullion and ore of shipping grade, containing silver, gold, and some lead.

STOREY COUNTY.

Mine production in Storey County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	21	50,376	$355,640	395,784	223	2,958	$799,116
1920	20	58,494	321,982	324,744	.....	.....	675,953
Increase or decrease, 1920	−1	+8,118	−33,658	−71,040	−223	−2,958	−123,163

Comstock district.—The entire output shown in the above table came from the Comstock district, where there was a decrease in the production of gold and silver. Twenty producers reported 58,494 tons of ore mined, including 19,300 tons of old tailing treated in cyanidation plants and 3 tons of ore shipped directly to the smelter.

The United Comstock Mines Co. controls at Gold Hill the Alpha, Imperial, Challenge & Confidence, Yellow Jacket, Crown Point, Belcher, and Kentuck mines. These mines cover 3,175 feet on the lode, with a recorded production said to have amounted to $118,613,000. Present development has been confined to the Imperial and Challenge & Confidence mines, in which more than 2,000,000 tons of ore is conservatively reported to be blocked out, and to have an average value of $6.75 a ton in gold and silver. The ore is to be treated by cyanidation in a mill, at a site on American Flat, about 2 miles southeast of the mines. From this site a 10,000-foot mine adit is now being driven to connect with the various workings. The adit was about 500 feet long and was being driven about 16 feet a day. A spur track from the Virginia & Truckee Railway is under construction for the transportation of machinery and supplies.

The Consolidated Virginia, Ophir, Mexican, and Sierra Nevada mines, termed the "Northend" mines by the new controlling interest, are also being put into shape to produce at an increased rate. Changes are being made in the Mexican mill and a second Oliver filter is to be installed so that the quantity of ore treated can be increased from 90 to 150 tons a day. The surface plant of the C. & C. shaft, erected in 1874, has been entirely changed. The great steam-driven hoist, for many years the pride of Virginia City and the last

hoist of that type remaining on the Comstock lode, was removed and replaced by a modern electric hoist. Changes were made in the pumping system in the mine and two pumps now raise the water from the lower levels to the Sutro tunnel. According to the report of the Consolidated Virginia Mining Co. 17,706 tons of ore was treated at the Mexican mill and produced gold and silver bullion valued at $353,960.50. Treatment charges amounted to $52,772.72.

The output of the Ophir mine for 1920 was 2,270 tons of ore, valued at $57,956.61. All the ore was treated at the Mexican mill, of which a one-third interest is owned by the Ophir and Consolidated Virginia companies.

Low-grade ore from the Chollar and Potosi mines has been treated for years by the Comstock Leasing Co., which operated a 100-ton cyanide mill about three-fourths of a mile from the mine. The crushing and grinding department at the mill consists of rolls and a ball mill, the ore being slimed and subjected to cyanide solution. The Hale & Norcross mine is being developed through the Chollar mine, as its old workings are inaccessible.

The Comstock & Gold Hill United Mines Co., recently incorporated, owns claims at Gold Hill, and shipments of ore to the McTigue amalgamation mill at Silver City gave returns of $70 and $100 a ton. Four-fifths of the value of the ore is in gold. Lessees working part of the ground extracted ore of good grade.

WASHOE COUNTY.

Leadville district.—There was more activity than usual in the Leadville district. The Comrade Silver and Leadville mines were operated and both produced silver-lead ore. Most of the output was milled in a 50-ton flotation plant of the Leadville Mines Co., which was improved during 1920.

Peavine district.—The Standard Metals Co. put its 50-ton concentration mill in operation late in 1920 and shipped some high-grade silver ore containing copper. Some ore was also produced from the property of the National Copper Co.

White Horse district.—The output in the White Horse district of 229 tons of ore, most of which was treated by amalgamation, was produced by nine operators. The ore yielded gold bullion, containing silver. Only 4 tons of ore mined was of sufficiently high grade to ship directly to the sampling works.

WHITE PINE COUNTY.

Mine production in White Pine County, Nev., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	29	2,277,428	$325,995	134,047	47,912,943	1,342,061	2,952,279	$9,674,580
1920	38	2,597,236	475,644	140,954	48,372,471	2,123,259	1,314,837	9,806,182
Increase or decrease, 1920...	+9	+319,808	+149,649	+6,907	+459,528	+781,198	−1,637,442	+131,602

[a] Includes placer production.

Aurum or Silver Canyon district.—Some silver ore from previous operations at the Siegel mine was shipped to the smelter in 1920. One lot of silver was also shipped from the property of the White Pine Copper Co.

Cherry Creek district.—Eight producers in the Cherry Creek district reported the output of 1,180 tons of ore, containing $1,801 in gold, 16,735 ounces of silver, 11,249 pounds of lead, and a little copper, valued at $20,975, or $17.77 a ton. The ore directly smelted amounted to 430 tons, and the remainder was treated in a flotation plant and produced a few tons of lead concentrate, containing gold and silver. The principal producers of ore were the Nevada Star and Champion properties. Some ore was also shipped from the Black Metal and Oversight mines.

Duck Creek district.—Lead ore, containing a little silver, was shipped from the Hyrum claim and two other properties. The total value of the ore was $495.

Hunter district.—One lot of old slag and some crude ore were shipped directly to the smelter from the Vulcan property, which was operated by lessees.

Osceola district.—From the Sunrise group several tons of ore were milled which produced bullion by amalgamation.

Pinto district.—Two lots of silver-lead ore were shipped to the smelter in 1920 from a group which includes the Washington, Mareland, and Silver Stone claims.

Robinson district.—The production of the Robinson district was as follows:

Mine production in Robinson district, White Pine County, Nev., 1904–1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	8	2,273,961	$323,143	56,129	47,871,048	137,768	2,952,279	$9,512,841
1920	12	2,589,546	471,510	65,008	48,347,828	136,194	1,314,837	9,555,766
Increase or decrease, 1920	+4	+315,585	+148,367	+8,879	+476,780	−1,574	−1,637,442	+42,925
Total, 1904–1920	.....	37,586,260	6,130,593	1,072,177	833,579,170	2,758,435	4,962,652	162,807,879

Production at the Nevada Consolidated mine [12] was 50 per cent of the producing capacity. Of the output of ore, 30.8 per cent came from the Ruth underground ore body and 69.2 per cent from the Eureka shovel pit ore body, or a total of 2,562,478 tons of ore, averaging 1.466 per cent of copper. In addition to this ore, 4,608 dry tons of sulphide ore, averaging 10.9 per cent of copper, was mined from the Ruth ore body taken out in developing the new contact ore body on the 700-foot level. The output of refined copper was 48,311,985 pounds, against 43,971,892 pounds for 1919. Dividends distributed to stockholders amounted to $1,499,592.75, which brings the total since

[12] Nevada Consolidated Copper Co. Ann. Rept. for year ending Dec. 31, 1920.

the beginning of operations to $46,768,616.60. The following paragraphs are taken from the company's annual printed report:

> Including the regular charge to cover depreciation of plant and equipment, the total operating cost per pound of copper produced in the year was 19.17 cents; applying the usual credits for gold and silver and for miscellaneous earnings, amounting to 1.89 cents, gives a net cost of 17.28 cents per pound of refined copper, as compared with 16.14 cents per pound on similarly calculated costs for the year 1919. * * *
>
> The operating costs for 1920 were somewhat higher than in 1919, due in part to wage increase, beginning in April, 1920, which reestablished the same wage in effect at the close of the war, and also to general freight rate increase on raw and finished materials largely used in operations. The 1920 cost for supplies averaged higher than 1919. This was particularly true of coal, an important element of copper costs for power and smelting requirements.

Very little was done at the property of the Consolidated Coppermines Co. In March there was a reduction in the working force and no ore was mined on company account, but lessees shipped some oxidized zinc ore, sulphide lead ore, and copper ore. Other producers shipping small lots of copper ore were the Monarch, Blue Point, and Florence. The Golden Rule, Brownstone, Ely Metals, and Moonlight properties yielded lead ore.

Ward (Taylor) district.—The Ward mine was under development and lessees produced considerable ore, containing principally lead and silver. Some silver bullion was recovered from the cyanidation of dump ore from the property of the Wyoming Mining Co.

White Pine district.—Six producers in the White Pine district reported 453 tons of ore, containing $288 in gold, 10,903 ounces of silver, 19,887 pounds of copper, and 413,009 pounds of lead, valued in all at $48,872, or an average of $107.88 a ton. Included in the output was 61 tons of old tailings containing copper shipped directly to the smelter. The producers were the Great Valley, Jennie A., Black Jack, Nevada, Rocco Homestake, and Young Treasure properties.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA.

(MINES REPORT.)

By V. C. Heikes.[1]

PRODUCTION.

GENERAL STATEMENT.

Although curtailment of production continued at most mines in Arizona, the output in 1920 exceeded that of 1919. It became evident to the mine operators early in the year that the declining prices of metals would force many mines to close.

Mine production of gold, silver, copper, lead, and recoverable zinc in Arizona in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	339	13,727,403	$4,506,413	5,266,605	538,100,844	10,203,078	1,717,000	$111,157,872
1920	318	14,920,478	4,786,122	5,355,303	558,256,302	14,599,765	1,457,296	114,628,584
Increase or decrease, 1920	−21	+1,193,075	+279,709	+88,698	+20,155,458	+4,396,687	−259,704	+3,470,712

[a] Includes placer production.

Gold, copper, and lead increased in value in 1920; silver increased in quantity, but decreased in value; and zinc decreased in both quantity and value. Dividends paid in 1920 by 11 companies amounted to $15,946,268. This does not include dividends of $4,500,000 paid in 1920 by the Phelps Dodge Corporation, owning mines in Mexico, New Mexico, and Arizona.

ORE.

With the increase of ore in Arizona, the average value per ton decreased from $8.10 in 1919 to $7.68 in 1920, and the gold and silver

[1] Valuable assistance in the preparation of the report and the compilation of the statistical tables was rendered by B. N. Patchell, of the United States Geological Survey.

value per ton from 76 to 71 cents. The dry or siliceous ores, principally from Mohave and Cochise counties, decreased 13,974 tons. The 201,334 tons of siliceous gold ore averaged $14.36 in gold and 0.50 ounce of silver to the ton. The 78,190 tons of siliceous silver ores averaged per ton $2.49 in gold, 12.11 ounces of silver, and a little copper and lead. Of this ore, 49,829 tons was produced in the Turquoise and Tombstone districts of Cochise County.

Of the copper ore mined in Arizona, 10,371,159 tons came from low-grade disseminated deposits near Globe, Ray, and Ajo, where most of the ore was treated. The richer siliceous ore, or that valuable as converter lining, was shipped to smelters. Similar disseminated copper ore amounting to 1,030,437 tons was mined and milled from the low-grade copper deposits in the Clifton and Morenci camps of Greenlee County. The crude copper ore mined and smelted directly (without previous concentration) amounted to 2,362,250 tons.

Ore and metals produced in Arizona in 1920.

Source of production.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.
		Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Placers	8	.....	220.93	15	.....	.....	.....
Dry or siliceous ore	139	280,701	149,518.03	1,051,982	505,153	46,123	.....
Copper ore	108	14,516,580	76,402.41	3,716,246	557,364,143	.....	.....
Lead ore	75	116,269	5,352.21	521,441	213,346	13,641,815	.....
Zinc ore	1	1,820	.....	.....	.....	69,790	1,457,296
Copper-lead ore	11	5,108	35.07	65,619	173,660	842,037	.....
		14,920,478	231,528.65	5,355,303	558,256,302	14,599,765	1,457,296

Ore sold or treated in Arizona in 1920, in short tons.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Total.
Cochise	51,895	1,394,206	95,379	.....	.....	1,541,480
Coconino	.....	114	.....	.....	.....	114
Gila	2,379	7,408,567	4,097	.....	9	7,415,052
Graham	2	.....	1,726	.....	.....	1,728
Greenlee	3,399	1,032,471	.....	.....	.....	1,035,870
Maricopa	542	160	93	.....	.....	795
Mohave	200,096	622	2,440	.....	.....	203,158
Pima	171	1,776,614	469	.....	55	1,777,309
Pinal	1,630	1,827,498	125	.....	2,423	1,831,676
Santa Cruz	2,005	4,226	2,765	.....	2,621	11,617
Yavapai	18,533	1,014,962	2,928	1,820	.....	1,038,243
Yuma	49	57,140	6,247	.....	.....	63,436
	[a] 280,701	14,516,580	116,269	1,820	5,108	14,920,478
Value per ton in gold and silver	$15.10	$0.39	$5.84	.....	$14.14	$0.71

[a] Includes 201,334 tons of gold ore, 1,177 tons of gold and silver ore, and 78,190 tons of silver ore.

GOLD.

Gold recovered from ores and tailings treated in gold and silver mills came largely from Mohave County and represented more than 60 per cent of the total production, and gold in crude ores shipped to smelters nearly 32 per cent. From ores treated in mills by amalgamation gold valued at $27,760 was recovered and that from ores treated by cyanidation amounted to $2,845,662. Concentrates contained $390,739, against $350,678 in 1919, and ores shipped directly

to smelters contained $1,514,950, against $1,544,812 in 1919. The chief producing districts were the San Francisco district, in Mohave County, where siliceous gold ores were produced; the Warren district in Cochise County, where copper ores were produced; and the Verde district, in Yavapai County, where both siliceous and copper ores were produced.

Of the mines producing gold the United Eastern was first, with 101,161.24 ounces, and the Tom Reed mine was second. Both these mines, which are at Oatman, produce siliceous ores. The Calumet & Arizona, at Bisbee, and the United Verde, at Jerome, producers of copper ore, made the next largest outputs of gold.

Mine production of gold in Arizona in 1920, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Total.
Cochise		4,579.76	35,102.47	4,782.47		44,464.70
Gila		148.43	6,740.74	185.68	10.30	7,085.15
Graham		.44		.48		.92
Greenlee		644.11	3,218.20			3,862.31
Maricopa	10.01	490.91	25.80	2.89		529.61
Mohave		137,719.37	1.50	251.45		137,972.32
Pima	58.78	7.89	132.30	10.84	17.50	227.31
Pinal		74.03	5,087.02	11.66	3.70	5,176.41
Santa Cruz		15.19	17.06	14.78	3.57	50.60
Yavapai	152.14	5,800.41	25,861.03	91.72		31,905.30
Yuma		37.49	216.29	.24		254.02
	220.93	[a]149,518.03	76,402.41	5,352.21	35.07	231,528.65

[a] Includes 139,857.94 ounces from gold ore, 236.75 ounces from gold and silver ore, and 9,423.34 ounces from silver ore.

SILVER.

The mine production of silver increased in Yavapai, Gila, Greenlee, Yuma, and Maricopa counties. Bullion from gold and silver ores contained 129,211 ounces of silver recovered by cyanidation and 460 ounces recovered by amalgamation. Concentrates contained more than 21 per cent of the total output of silver and crude ore shipped to smelters 76 per cent.

Nearly 56 per cent of the total silver came from the ore of five copper properties—the United Verde, Calumet & Arizona, Copper Queen, Shattuck, and Bunker Hill mines.

Mine production of silver in Arizona in 1920, in fine ounces.

County.	Placers.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Total.
Cochise		584,452	1,362,349	368,176		2,314,977
Coconino			99			99
Gila		37,919	530,443	26,103	514	594,979
Graham		32		9,429		9,461
Greenlee		59,157	88,271			147,428
Maricopa	1	31	458	620		1,110
Mohave		116,481	1,710	29,421		147,612
Pima	10	2,054	25,631	7,741	711	36,147
Pinal		21,544	375,424	921	34,394	432,283
Santa Cruz		22,811	25,933	28,276	30,000	107,020
Yavapai	4	207,461	1,301,747	45,863		1,555,075
Yuma		40	4,181	4,891		9,112
	15	[a]1,051,982	3,716,246	521,441	65,619	5,355,303

[a] Includes 99,679 ounces from gold ore, 5,306 ounces from gold and silver ore, and 946,997 ounces from silver ore.

COPPER.

The year 1920 was extremely unsatisfactory for the copper industry in Arizona. Crude ore shipped directly to the smelters yielded more than 46 per cent of the total quantity. Of the output from crude ore smelted in 1920, Cochise County produced nearly 45 per cent. The copper in concentrates produced at milling plants decreased. Arizona probably produced in 1920 more than 45 per cent of the copper from ore mined in the United States, and nearly half of this quantity came from the low-grade disseminated ores. These ores in Pima, Pinal, and Gila counties yielded 224,132,635 pounds of copper, against 219,539,871 pounds in 1919. Similar low-grade copper deposits exist in Greenlee County, so that the total production from the disseminated deposits in Arizona was 259,227,635 pounds, or more than 46 per cent of the aggregate output in 1920. In 1919 these ores altogether produced 264,262,320 pounds of copper.

Ten properties, each yielding more than 10,000,000 pounds, produced more than 89 per cent of the total quantity of copper. The Inspiration was first, followed by the Copper Queen, United Verde, Miami, Ray Consolidated, United Verde Extension, Calumet & Arizona, New Cornelia, Arizona Copper, and Old Dominion mines. Many of the larger companies had from one to six months' product of unsold copper on hand. Most of the copper was produced under conditions of high wages and high costs of supplies, and the market price at the end of 1920 was less than the cost of production at many mines. Some companies discontinued the production of copper early in November.

Mine production of copper in Arizona in 1920, in pounds.

County.	Dry or siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Total.
Cochise	153,649	121,284,709	68,142	.....	121,506,500
Coconino	.....	13,802	.....	.....	13,802
Gila	26,829	179,449,354	97,915	529	179,574,627
Graham	.....	.....	4,612	.....	4,612
Greenlee	4,310	35,743,966	.....	.....	35,748,276
Maricopa	.....	43,778	.....	.....	43,778
Mohave	5,305	109,493	6,327	.....	121,125
Pima	2,350	44,831,540	14,055	6,724	44,854,649
Pinal	1,695	57,059,472	255	8,898	57,070,320
Santa Cruz	60,594	623,066	15,865	157,509	857,034
Yavapai	250,255	114,681,179	5,646	.....	114,937,080
Yuma	166	3,523,784	549	.....	3,524,499
	[a] 505,153	557,364,143	213,346	173,660	558,256,302

[a] Includes 6,537 pounds from gold ore, 8,595 pounds from gold and silver ore, and 490,021 pounds from silver ore.

LEAD.

Cochise County, principally the Warren or Bisbee district, had the largest yield of lead, and was followed by Gila and Santa Cruz counties.

Three mines in Arizona produced more than 75 per cent of the total lead, and each of them produced more than 700,000 pounds; they were the Shattuck mine, at Bisbee, the Seventy-nine mine, in the Banner district, and the Duquesne mine, in the Patagonia district.

Prices for lead continued fairly satisfactory to the operators until November, when the price was reduced gradually, causing some of the lead mining and milling operators to close their plants before December 1.

Mine production of lead in Arizona in 1920, in pounds.

County.	Dry or siliceous ore.	Lead ore.	Zinc ore.	Copper-lead ore.	Total.
Cochise	43,190	9,506,735			9,549,925
Gila	236	1,645,590		1,601	1,647,427
Graham		295,477			295,477
Maricopa		75,765			75,765
Mohave		513,302			513,302
Pima	734	185,062		24,196	209,992
Pinal		93,600		35,656	129,256
Santa Cruz	1,922	792,824		709,335	1,504,081
Yavapai		192,960	60,750		253,710
Yuma		302,262			302,262
	[a] 46,123	13,581,315	60,750	862,947	14,549,135

[a] Includes 1,179 pounds from gold ore and 44,944 pounds from silver ore.

ZINC.

The Arizona Hillside property, in Yavapai County, was the only producer of zinc ore in 1920. All the ore was sulphide and was shipped to eastern refineries.

MINING INDUSTRY.

It became evident to many mining companies early in 1920 that the output of metals, especially copper, was growing instead of decreasing. This condition, with a scarcity of orders from consumers, caused several mines to close before the end of the year. It was bad business to continue production with unsettled labor conditions, exorbitant costs of materials, and the disheartening and inadequate prices of the copper market. At the beginning of 1920 sales of copper were fairly satisfactory and it was hoped that production, which then approximated 50 to 75 per cent of normal, might possibly be increased to normal by the end of the year.

Freight rates[2] advanced to such a point that certain interests sought relief through the proposed construction of the railroad from the town of Ajo to a port on the Gulf of Lower California. This line would be a continuation of the present railroad from Gila Bend (on the main line of the Southern Pacific Co.) to Ajo and would offer water transportation from the proposed port through the Panama Canal to the refineries in the East. Mining companies operating in the Southwest objecting to the high prices for blasting powder subscribed, in proportion to their powder consumption, to a majority interest in a company formed for the purpose of building and operating a powder plant. Such a plant is being built by the Apache Powder Co. near Benson.

[2] Eng. and Min. Jour., vol. 111, p. 161, Jan. 22, 1921.

REDUCTION MILLS.

A list of milling plants operating and idle in 1920, giving the equipment of each plant, has been prepared and a multigraphed copy may be had upon request to the Bureau of Mines, Washington, D. C.

Gold and silver produced at mills in Arizona in 1920.

County.	Ore.	Bullion recovered from ore by—				Total value.
		Amalgamation.		Cyanidation.		
		Gold.	Silver.	Gold.	Silver.	
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	
Cochise	3,890	795.09	409	[a] 435.00	[a] 35,377	$64,435
Graham	2			.44	32	44
Maricopa	535	453.56	25	22.86	4	9,881
Mohave	198,456	24.79	12	137,195.59	[b] 93,781	2,938,831
Pinal	75	15.31	5			322
Yavapai	68	35.46	7	5.00	17	862
Yuma	20	18.68	2			388
	203,046	1,342.89	460	137,658.89	129,211	3,014,763

[a] Includes bullion from 5,089 tons of old tailings.
[b] Includes bullion from 400 tons of old tailings.

Concentration plants reduced 10,296,849 tons of ore to 635,817 tons of concentrates.

Mine production of metals from Arizona concentrates in 1920.

By counties.

County.	Ore to concentrating mills.	Concentrates produced.	Gold.	Silver.	Copper.	Lead.	Total value of concentrates.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	
Cochise	95,430	15,670	4,643.49	328,797	128,327	8,908,616	$1,190,680
Gila	7,191,940	306,827	4,503.00	273,997	160,791,705	27,500	29,979,616
Graham	1,696	424	.50	8,576	4,552	252,022	30,358
Greenlee	996,825	109,298	2,400.00	66,000	30,545,000		5,741,833
Mohave	1,554	219	18.83	2,585	558	186,840	18,257
Pima	10,811	1,297	98.79	1,016	409,569		78,510
Pinal	1,816,731	159,876	4,066.19	333,586	53,259,522	9,468	10,248,175
Santa Cruz	1,612	403		3,496	2,936	218,886	21,861
Yavapai	121,959	34,859	3,171.00	99,760	5,394,918	82,116	1,173,522
Yuma	58,291	6,944	.21	7,689	2,969,443	379,801	585,146
	10,296,849	635,817	18,902.01	1,125,502	253,506,530	10,065,249	49,067,958

By kinds of concentrates.

Dry or siliceous		185	434.10	7,977	1,585	1,179	$18,054
Copper		618,645	14,069.18	718,160	253,442,930		47,707,129
Lead		16,953	4,396.13	366,080	54,620	10,054,602	1,304,321
Copper-lead		34	2.60	33,285	7,395	9,468	38,454

Mine production of metals from Arizona concentrates in 1920—Continued.

Average content.

Kind of concentrates.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	
Dry or siliceous	185	2.35	43.12	0.43	0.32	$97.59
Copper	618,645	.02	1.16	20.48	.....	77.12
Lead	16,953	.26	21.59	.16	29.65	76.94
Copper-lead	34	.08	978.97	10.88	13.93	1,131.00
	635,817	.03	1.77	19.94	.79	77.17

Of the material smelted, the copper ores constituted the largest part. The Warren or Bisbee district, in Cochise County, produced nearly 48 per cent. The dry or siliceous ores formed the next largest quantity, followed by lead ores.

Mine production of metals from Arizona crude ore shipped to smelters in 1920.

By counties.

County.	Crude ore to smelter.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces*	*Fine ounces*	*Pounds.*	*Pounds.*	*Pounds.*	
Cochise	1,201,096	38,535.89	1,939,704	116,810,541	641,290	.....	$24,455,327
Coconino	114	.....	99	13,802	.....	.....	2,648
Gila	217,372	2,582.13	320,982	18,682,240	1,622,927	.....	3,970,614
Graham	30	.....	853	60	16,455	.....	2,257
Greenlee	39,045	1,462.31	81,428	5,203,276	.....	.....	1,076,389
Maricopa	260	43.20	1,080	43,778	75,733	.....	16,184
Mohave	2,748	733.11	51,234	120,567	327,062	.....	119,349
Pima	37,056	61.74	31,714	4,908,684	209,989	.....	955,841
Pinal	14,870	1,094.90	98,692	3,810,798	119,786	.....	840,978
Santa Cruz	8,430	50.61	93,881	796,030	1,362,613	.....	358,854
Yavapai	915,145	28,486.73	1,448,976	108,732,467	156,180	1,457,296	22,305,566
Yuma	5,125	235.10	1,421	555,056	2,481	.....	108,738
	2,441,591	73,285.72	4,070,064	259,677,299	4,534,516	1,457,296	54,212,745

By kinds of ore.

Dry or siliceous	65,168	9,971.94	887,750	438,333	44,944	.....	$1,258,035
Copper	2,362,250	62,325.21	2,991,619	258,913,975	.....	.....	52,192,683
Lead	9,645	956.09	155,361	158,726	3,587,213	.....	505,290
Zinc	1,820	.....	.....	.....	69,790	1,457,296	123,624
Copper-lead	2,708	32.48	32,334	166,265	832,569	.....	133,113

Average content.

Kind of ore.	Crude ore to smelter.	Gold.	Silver.	Copper.	Lead.	Recoverable zinc.	Total value.
	Short tons.	*Fine ounces per ton.*	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*	
Dry or siliceous	65,168	0.15	13.62	0.34	0.03	.....	$19.30
Copper:							
Oxidized	582,411	.01	1.00	5.61	.....	.....	22.03
Sulphide	1,779,839	.03	1.35	5.44	.....	.....	22.12
Lead:							
Oxidized	7,705	.08	10.90	.91	18.70	.....	46.83
Sulphide	1,940	.19	36.78	.47	18.20	.....	74.83
Zinc:							
Sulphide	1,820	.....	.....	.....	1.92	40.04	67.93
Copper-lead:							
Oxidized	71	.07	21.97	3.61	22.98	.....	75.37
Sulphide	2,637	.01	7.88	3.07	15.17	.....	48.45
	2,441,591	.03	1.67	5.32	.09	.03	22.20

PRODUCTION BY COUNTIES.

GENERAL TABLES.

Ore sold or treated, number of deep mines producing, and average value of ore per ton in Arizona in 1919 and 1920.

County.	Ore sold or treated, 1920.		Number of deep mines producing.		Average total value per ton.[a]		Average value per ton in gold and silver.[a]	
	Quantity.	Increase or decrease.	1919	1920	1919	1920	1919	1920
	Short tons.	*Short tons.*						
Cochise	1,541,480	+ 164,273	38	44	$19.92	$17.23	$2.65	$2.23
Coconino	114	+ 11	2	2	66.01	23.23	7.31	.95
Gila	7,415,052	+1,040,812	46	36	5.25	4.58	.10	.11
Graham	1,728	— 728	4	3	25.45	18.90	7.46	5.98
Greenlee	1,035,870	— 265,329	14	10	6.56	6.58	.14	.23
Maricopa	795	+ 638	5	11	50.55	32.78	4.98	15.03
Mohave	203,158	+ 2,118	40	34	14.28	15.14	13.76	14.83
Pima	1,777,309	+ 124,985	29	35	4.97	4.68	.03	.02
Pinal	1,831,676	— 197,850	28	30	6.25	6.05	.38	.32
Santa Cruz	11,617	— 13,184	23	26	21.47	34.60	10.22	10.13
Yavapai	1,038,243	+ 300,022	74	67	23.13	22.77	2.73	2.26
Yuma	63,436	+ 37,307	21	12	8.44	10.94	.96	.24
	14,920,478	+1,193,075	324	310	8.10	7.68	.76	.71

[a] Placer product excluded.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1920.

County.	Gold.					Silver.	
	Placers.		Deep mines.		Total value.	Quantity.	Value.
	Quantity.	Value.	Quantity.	Value.			
	Fine ounces.		*Fine ounces.*			*Fine ounces.*	
Cochise			44,464.70	$919,167	$919,167	2,314,977	$2,523,325
Coconino						99	108
Gila			7,085.15	146,463	146,463	594,979	648,527
Graham			.92	19	19	9,461	10,312
Greenlee			3,862.31	79,841	79,841	147,428	160,697
Maricopa	10.01	$207	519.60	10,741	10,948	1,110	1,210
Mohave			137,972.32	2,852,141	2,852,141	147,612	160,897
Pima	58.78	1,215	168.53	3,484	4,699	36,147	39,400
Pinal			5,176.41	107,006	107,006	432,283	471,188
Santa Cruz			50.60	1,046	1,046	107,020	116,652
Yavapai	152.14	3,145	31,753.16	656,396	659,541	1,555,075	1,695,032
Yuma			254.02	5,251	5,251	9,112	9,932
	220.93	4,567	231,307.72	4,781,555	4,786,122	5,355,303	5,837,280

County.	Copper.		Lead.		Recoverable zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Cochise	121,506,500	$22,357,196	9,549,906	$763,992			$26,563,680
Coconino	13,802	2,540					2,648
Gila	179,574,627	33,041,731	1,650,427	132,034			33,968,755
Graham	4,612	849	268,477	21,478			32,658
Greenlee	35,748,276	6,577,683					6,818,221
Maricopa	43,778	8,055	75,733	6,059			26,272
Mohave	121,125	22,287	513,902	41,112			3,076,437
Pima	44,854,649	8,253,255	209,989	16,799			8,314,153
Pinal	57,070,320	10,500,939	129,254	10,340			11,089,473
Santa Cruz	857,034	157,694	1,581,499	126,520			401,912
Yavapai	114,937,080	21,148,423	238,296	19,064	1,457,296	$118,041	23,640,101
Yuma	3,524,499	648,508	382,282	30,583			694,274
	558,256,302	102,719,160	14,599,765	1,167,981	1,457,296	118,041	114,628,584

COCHISE COUNTY.

Mine production in Cochise County, Ariz., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	43	1,377,207	[a] $940,538	[a] 2,421,905	126,483,923	4,851,238	$27,436,198
1920	44	1,541,480	919,167	2,314,977	121,506,500	9,549,906	26,563,680
Increase or decrease, 1920	+1	+164,273	−21,371	−106,928	−4,977,423	+4,698,668	−872,518

[a] Includes placer production.

In Cochise County all metals except lead decreased in quantity. The value of the output of silver decreased from $2,712,534 to $2,523,325, gold from $940,538 to $919,167, and copper from $23,526,010 to $22,357,196, but lead increased from $257,116 to $763,992. No zinc was reported in 1920. Ores of smelting grade (1,201,096 tons) predominated and averaged $20.36 a ton. The total content of each metal is given in the table on page 345. Of the ores smelted 1,157,964 tons was classified as copper ore, of which 474,822 tons were estimated to be oxidized ore and 683,142 tons sulphide ore. All the lead ore smelted, 2,677 tons, was shipped to plants outside the State, and contained 405.90 ounces of gold, 41,567 ounces of silver, 23,323 pounds of copper, and 599,300 pounds of lead. All but 47 tons of this ore was oxidized. Milling ore produced 15,346 tons of lead concentrate, which was also shipped. No placer output was reported.

California (Paradise) district.—Two lots of siliceous silver ore were shipped to the smelter at Douglas from the Bradshaw Arizona and Homestake properties.

Cochise district (Johnson and Dragoon.)—Six producers in the Cochise district reported 13,826 tons of ore, containing $258 in gold, 14,624 ounces of silver, 1,149,833 pounds of copper, and 48,818 pounds of lead, valued in all at $231,672, or $16.76 a ton. Included in this output was 2,328 tons of milling ore of concentrating grade, containing principally copper and silver. The Arizona-United Co., operating the Mammoth group, had the largest output of shipping ore, containing copper and silver. Smaller lots of ore were shipped from the Copper Chief and Texas-Arizona properties. The Middlemarch mine, in the Dragoon Mountains, produced some copper concentrate, but the mill was closed in September on account of the shortage of water.

Dos Cabezas district.—Most of the 1,445 tons of ore produced in the Dos Cabezas district came from the Dives group, which yielded gold bullion containing silver recovered from ore treated in a 10-stamp amalgamation mill. Similar ore was milled at the Gold Prince property and produced concentrates.

Swisshelm district (Webb).—The Great American Mining Co. and the Swisshelm Gold Silver Co. were producers of copper ore, containing silver and gold.

Tombstone district.—Fifteen producers in the Tombstone district reported 28,946 tons of ore and also gold and silver bullion recovered from 2,061 tons of old tailings. The total output contained $36,953 in gold, 456,855 ounces of silver, 144,010 pounds of copper, and 243,946 pounds of lead, valued in all at $580,939, or $18.74 a ton. The Bunker Hill property, which was divided into several leases, produced the largest part of the output; shipments were also made from the Hershell, Free Coinage, Mellgren group, operated by the Silverfields Co., Old Guard, Ninety-six, Rocky Bar, Solstice, and Sunset properties.

Turquoise district (Courtland and Pearce).—Nine properties in the Turquoise district produced 37,442 tons of ore, including some old tailings which were re-treated in the district. The total output contained $49,297 in gold, 155,840 ounces of silver, 1,763,050 pounds of copper, and 8,918 pounds of lead, valued in all at $544,276, or $14.54 a ton. Silver bullion containing gold was recovered from 2,890 tons of ore and 5,089 tons of old tailings. The largest part of the output was bullion from the Commonwealth mine, which also produced silver ore of shipping grade. The Leadville Mining Co. shipped the largest quantity of copper ore, and smaller quantities were produced from the Germania, Great Western, and Leonard properties. Small lots of ore were shipped from the Sadie and Poorman mines.

Warren district.—Seven producers in the Warren district reported 1,457,471 tons of ore, the bulk of which was directly smelted. Of the ore produced, 92,702 tons was concentrated and 233,914 tons of copper ore was leached. The ore directly smelted amounted to 1,130,855 tons and contained 34,726.73 ounces of gold, 1,352,262 ounces of silver, 113,836,030 pounds of copper, and 316,260 pounds of lead. The lead was contained in ore shipped to the smelter at El Paso, Tex., and the copper ore was treated at Douglas, Ariz. The Copper Queen and Calumet & Arizona mines produced the bulk of the copper ore and a small quantity of lead ore. Other properties producing ore in notable quantities were the Denn, Higgins, and Wolverine.

At the Copper Queen Branch production of copper from the "limestone" mines was curtailed, but the stripping of Sacramento Hill and the erection of the 4,000-ton concentrator proceeded actively. It is expected that the mill and the porphyry ore deposit known as the West Ore Body will be ready for productive operation by January 1, 1922, with an initial capacity of 4,000,000 pounds a month. According to the report [2] of the corporation it produced at Bisbee as follows:

[2] Phelps Dodge Corporation Ann. Rept. for year ending Dec. 31, 1920.

Ore and metals produced at Copper Queen mines, Arizona, 1920.

Kind of material and destination.	Quantity.	Gold.	Silver.	Copper.	Lead.
Shipped to Douglas:	*Short tons.*	*Ounces.*	*Ounces.*	*Pounds.*	*Pounds.*
Copper Queen Works—					
Underground, company	426,251	7,279	407,705	55,319,801	.....
Underground, lessees	88,476	1,034	58,557	6,643,403	.....
Precipitates	507	.....	60	327,281	.....
Steam shovel, high grade	4,151	21	887	150,238	.....
Calumet & Arizona smelter—					
Underground, company	54,318	314	10,660	3,735,744	.....
Underground, lessees	262	1	39	14,758	.....
Steam shovel, high grade	23,212	143	2,695	996,531	.....
Shipped to El Paso:					
Lead ore, lessees	827	54	6,095	15,354	243,836
Shipped to leaching dump:					
Steam shovel, low grade	233,914	.....	.....	4,240,286	.....
Shipped to steel mills:					
Manganese ore	254	.....	.....	.....	.....
Total, 1920	832,172	8,846	486,698	71,443,346	243,836
1919	.....	10,813	492,326	68,614,002	9,372
1918	.....	16,409	558,433	90,988,156	1,234,497
1917	.....	19,156	828,665	93,618,409	6,870,128
1916	.....	24,030	1,096,136	102,685,722	9,421,562

At the Calumet & Arizona mines [3] 493,672 dry tons of copper ore was mined. Of this output, 393,227 tons, averaging 4.89 per cent of copper, was shipped to its smelter at Douglas, and 65,880 tons of "exchange" ore of the same grade was shipped to the Copper Queen smelter, also at Douglas. The Ajo plant of the New Cornelia Copper Co. received 20,805 tons of low-grade high-sulphur ore, and the Old Dominion Co., at Globe, 24,775 tons. From this ore output 42,430,847 pounds of copper, 932,489 ounces of silver, and 32,519.68 ounces of gold were recovered. Dividends paid in 1920 amounted to $2,570,084, which, added to the total since 1903, makes $45,630,470.75.

From the Shattuck mine [4] 19,175 dry tons of copper ore and 93,061 dry tons of lead ore were mined and treated, which had a value of $1,529,669.89. From the copper ore smelted at Douglas 2,374,148 pounds of copper, 73,718 ounces of silver, and 575 ounces of gold were recovered. The lead concentrate shipped to El Paso, Tex., yielded 8,254,603 pounds of lead, 326,609 ounces of silver, and 4,377 ounces of gold. One small lot of lead ore was directly smelted. No dividends were declared. Owing to the low price of copper its production was reduced so that more men could be employed to maintain the output of lead ore. The production of copper ore was discontinued early in November.

Satisfactory results were reported at the Shattuck mill [5]

from the application of flotation to the concentration of silver-lead carbonate ores. The mill has a capacity of 400 to 500 tons of ore a day. After coarse concentration on tables, the ore is ground fine in ball and tube mills, then classified in cones, the overflow from the cones (containing 90 per cent minus 200 [finer than 200 mesh]) going to flotation, while the spigot discharge from the cones goes to tables. The slime overflow (all through 100 mesh) is thickened and sulphidized by a weak solution of sodium sulphide, after which it is

[3] Calumet & Arizona Mining Co. Ann. Rept. for year ending Dec. 31, 1920.
[4] Shattuck Arizona Copper Co. Ann. Rept. for year ending Dec. 31, 1920.
[5] Eng. and Min. Jour., vol. 111, p. 199, Jan. 22, 1921. For a full description of mill see vol. 110, p. 759, Oct. 16, 1920.

agitated and then treated in eight oil-flotation machines arranged in four series of two cells each. The froth from the first cell in each series is collected in a thickener, from which the thickened product passes to a filter, which discharges into storage bins ready for shipment to local smelters. The froth from the second cells is returned to the agitator which feeds the flotation system, and the tailings from the second series of cells go to waste.

COCONINO COUNTY.

Francis district.—Several lots of copper ore mined near Grand Canyon were shipped directly to the smelters.

GILA COUNTY.

Mine production in Gila County, Ariz., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	46	6,374,240	$163,311	439,647	176,527,981	94,526	$33,494,930
1920	36	7,415,052	146,463	594,979	179,574,627	1,650,427	33,968,755
Increase or decrease, 1920	−10	+1,040,812	−16,848	+155,332	+3,046,646	+1,555,901	+473,825

The output of gold in Gila County, valued at $163,311 in 1919, decreased to $146,463 in 1920; silver, copper, and lead increased in value. The ore produced was treated in the county, except lead ores and some copper ores, which were shipped to plants outside of the county. Of the copper ore smelted, 42,256 tons was oxidized and 168,821 tons sulphides. The 217,372 tons of smelting ores shipped had an average value per ton of $18.27, and 306,827 tons of concentrates, chiefly copper, an average value per ton of $97.71.

Banner district.—Five producers in the Banner district reported 66,503 tons of ore, containing $14,391 in gold, 30,582 ounces of silver, 3,356,815 pounds of copper, and 1,437,683 pounds of lead, valued in all at $780,394, or $11.73 a ton. The Christmas mine produced most of the copper ore, which contained some silver, and a large output of lead ore, containing copper and silver, was made from the Seventy-Nine group, a prospect newly opened. The ore, which comes from shallow workings, is oxidized and contains an average of about 60 cents in gold, nearly 4 ounces of silver to the ton, and 23 per cent of lead, with a little copper. Other producers were the Gila Canyon and Apex properties.

Globe (Miami) district.—Of the 7,348,437 tons of ore produced in the Globe district in 1920, only 150,757 tons was directly smelted and 5,740 tons was treated in an acid leaching mill. The largest producer of ore was the Inspiration mine, followed by the Miami, Old Dominion, and Copper Hill. The total output of the district contained $132,072 in gold, 557,608 ounces of silver, 176,215,409 pounds of copper, and 212,744 pounds of lead, valued in all at $33,180,519, or $4.51 a ton. From this ore there was shipped or smelted in the district 306,827 tons of concentrates, all copper except one lot of

concentrates containing lead, which, with crude lead ore, was shipped to El Paso, Tex. Several lots of lead ore, containing silver and some copper, were shipped from the New Dominion mine, and a large quantity of copper ore was produced from the Superior & Boston property. There was no change in the wage scale of the district during the year, but owing to the depressed condition of the copper market, the general slump in business, lower cost of commodities and service, the wages of all employees were reduced $1 per shift to take effect January 1, 1921. Freight on copper to the refineries is said to remain at more than 100 per cent higher than the pre-war cost.

The Old Dominion mine[6] produced 249,111 dry tons of ore, averaging 4.79 per cent of copper. This output consisted of 64,810 tons of smelting ore averaging 6.63 per cent of copper; 182,606 tons of concentrating ore averaging 4.15 per cent; and 1,695 tons of siliceous ore, used for converter lining, averaging 3.39 per cent. The total production for 1920, including the metal from custom ore, was 22,854,452 pounds of refined copper, 181,010 ounces of silver, and 3,484 ounces of gold. All the copper was delivered at an average price of 18.374 cents a pound. An intensive development campaign with the object of developing the ore further ahead of its extraction, was begun. The grade of the ore opened up on the east side of the mine from the sixteenth level down is reported particularly gratifying.

During 1920 the Inspiration Co.[7] extracted from its undercutting area 5,091,517 tons of ore averaging 1.139 per cent of copper. The Live Oak division produced 9,558 tons averaging 2.5 per cent of copper, and the Warrior 1,307 tons of copper ore averaging 5.02 per cent. Of this amount, 5,083,143 tons was of milling grade, 2,745 tons was treated at the experimental leaching plant, and 16,494 tons was shipped directly to the smelter. From the treatment of 5,100,572 tons of ore and concentrate 79,453,740 pounds of copper was produced. The cost of fine copper, including depreciation but excluding depletion and Federal taxes, was 14.173 cents a pound. Experiments begun in 1919 in the leaching and flotation of mixed oxidized and sulphide ores proved that the ore is amenable to such treatment and that the copper can be economically recovered.

At the Miami concentration plant the ore milled amounted to 1,801,958 tons, or an average of 4,977 tons a day for 362 days operated during 1920. The total refined copper recovered from 66,684 tons of concentrate (averaging 43.868 per cent) was 55,581,328 pounds, representing a mill extraction of 82.48 per cent. The total cost of milling the ore was 82.692 cents a ton; mining, $1.301; and general expense, 39.343 cents. The total cost was $2.521 a ton. The cost of the copper averaged 8.177 cents a pound. There was no new development in the low-grade or mixed sulphide and oxide ore bodies during 1920, so they remained the same—36,000,000 tons averaging 1.06 per cent of copper. A total of $22,950,659.25 has been paid in dividends, which includes those paid in 1920 amounting to $1,494,228. The No. 5 shaft, which is to be the main hoisting outlet at the Miami mine, was equipped with a new crushing plant.

[6] Old Dominion Co. Ann. Rept. for year ending Dec. 31, 1920.
[7] Inspiration Consolidated Copper Co. Ann. Rept. for year ending Dec. 31, 1920.

The Arizona Commercial mine[8] produced 77,972 tons of ore, which included 14,289 tons of smelting ore averaging 10.04 per cent of copper and 63,683 tons of concentrating ore averaging 5.22 per cent of copper. From the ore and concentrate smelted, 7,913,836 pounds of refined copper, 31,028 ounces of silver, and 1,722 ounces of gold were recovered. Of the refined copper produced, 5,214,021 pounds was sold and delivered at an average price of 18.578 cents a pound. Production costs during the year, exclusive of depletion and depreciation, were said to be as low as in most of the better times. No dividends have been paid since October, 1918.

The Superior & Boston mine[9] produced during the fiscal year 9,104 dry tons of ore, averaging 5.84 per cent of copper and 14.31 ounces of silver to the ton, and yielding in all 1,062,379 pounds of copper and 130,323 ounces of silver, for which the company received $212,003 after smelting and freight charges were deducted. In addition lessees shipped 489 tons of copper ore valued at $7,452. Considerable exploration work was done in 1920 on the Footwall, Black Oxide, North vein, and Great Eastern vein. Most of the work was done by diamond drilling.

At the Iron Cap mine[10] 50,186 dry tons of ore, averaging 5.04 per cent of copper, was produced. A total of 8,318 tons of concentrate, averaging 28.49 per cent of copper and 8.09 ounces of silver, was smelted. The concentrate contained 67,316 ounces of silver and 4,741,182 pounds of copper, representing a recovery of 90 per cent of the silver and 93.7 per cent of the copper. The average price received for copper was 17.44 cents a pound. The milling plant was completed about the middle of June, but up to that time the concentrating ore was shipped to the Inspiration mill and some of the siliceous ore to the smelter. In cutting the station in the shaft on the 1,500-foot level 30 feet of mineral ground was opened. The hanging wall of the main vein at that point is shale. The shaft entered schist a few feet below the 1,500-foot level. The vein has a greater width and carries more mineral than on the 1,400-foot level.

Richmond Basin district.—The Gila Monster mine, worked to a depth of 200 feet, and the Jumbo property were producers of silver ore, containing some copper.

GRAHAM COUNTY.

Aravaipa district.—Some milling ore from the Grand Reef property yielded lead concentrate, containing silver and a little copper.

Clark district.—One small lot of lead ore, containing silver, was shipped from the Clark district, 10 miles west of Safford.

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[8] Arizona Commercial Mining Co. Ann. Rept. for year ending Dec. 31, 1920.
[9] Superior & Boston Copper Co. Ann. Rept. for year ending Sept. 30, 1920.
[10] Iron Cap Copper Co. Eighth Ann. Rept., for year ending Dec. 31, 1920.

GREENLEE COUNTY.

Mine production in Greenlee County, Ariz., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	14	1,301,199	$70,002	106,241	44,867,643	1,294	$8,534,443
1920	10	1,035,870	79,841	147,428	35,748,276	.....	6,818,221
Increase or decrease, 1920	−4	−265,329	+9,839	+41,187	−9,119,367	−1,294	−1,716,222

Ashpeak district (*Duncan*).—Considerable silver ore, containing gold and a little copper, was shipped to the El Paso smelter from the Ashpeak Extension mine, which is opened by a 500-foot shaft. On the Ashpeak Mines Co.'s property about 100,000 tons of ore, averaging $12.20 in silver and gold, is developed [11] and a 60-ton mill was under construction in 1920.

Copper Mountain and Greenlee districts (*Morenci, Metcalf, and Clifton*).—All the output given in the county table, except that produced in the Ashpeak district, came from the Copper Mountain and Greenlee districts. Of the 1,035,031 tons of ore mined here, 4,594 tons was of shipping grade, from eight properties in the Copper Mountain district. Most of the remainder was low-grade milling ore containing copper mined by the Arizona Copper Co. in both districts. The total output of the two districts was $78,382 in gold, 129,775 ounces of silver, and 35,745,854 pounds of copper, valued in all at $6,797,074, or $6.57 a ton. All the Phelps Dodge properties were idle during 1920, but small lots of ore were shipped from the Copper Bluff, Pitt, Stargo, Big Medicine, and Galena properties.

Explorations in the low-grade area of the Detroit mines, owned by the Phelps Dodge Corporation, are reported encouraging,[12] and a very large quantity of ore has been located and partly developed. Operations were curtailed at this property pending a decision as to methods of mining and treating the ore deposits.

The Longfellow group of mines, at Morenci, and the Metcalf and Coronado groups, at Metcalf, were worked by the Arizona Copper Co. Its 4,500-ton concentrator and 1,000-ton smelting plant were operated at a reduced rate throughout 1920. Most of the output of the two districts was from this property.

MARICOPA COUNTY.

Most of the ore from Maricopa County (535 tons) was treated in gold and silver mills and produced bullion valued at $9,881. The remainder was shipped directly to smelters and had an average value of $62.25 a ton. A small quantity of placer bullion was reported in 1920.

Agua Fria district.—One small lot of copper ore, containing silver, was shipped from a prospect in the Agua Fria district.

[11] Goldfield Consolidated Mines Co. Ann. Rept. for year ending Dec. 31, 1920.
[12] Phelps Dodge Corporation Ann. Rept. for year ending Dec. 31, 1920.

Big Horn district (*Aguila*).—The output of the Brown Monster and Hauxhurst properties was 122 tons. Copper ore from the Hauxhurst property contained considerable gold, and ore from the Brown Monster contained lead and silver.

Cave Creek district.—Copper ore, containing silver and a little gold, was produced from the Go John property in 1920.

Vulture district.—There was little activity in the Vulture district in 1920, and only four properties reported production. The Black Bird group produced a small quantity of ore treated in the 10-stamp amalgamation mill, which yielded some gold bullion containing a little silver. A car lot of lead ore, containing silver, was shipped from the Montezuma mine to El Paso, Tex.

White Picacho district (*Hot Springs*).—Operations in 1920 on the Maricopa County side of the White Picacho district were slight. Some lead ore was shipped from the Prince of Arizona property.

Winafred district.—A few tons of siliceous gold ore was shipped to the smelter from the Eyrich gold property, which is opened by a 360-foot inclined shaft and is equipped with a 1-stamp Nissen mill that has never been completed.

MOHAVE COUNTY.

Mine production in Mohave County, Ariz., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	40	201,040	$2,582,331	164,517	302,667	916,818	$2,871,477
1920	34	203,158	2,852,141	147,612	121,125	513,902	3,076,437
Increase or decrease, 1920	−6	+2,118	+269,810	−16,905	−181,542	−402,916	+204,960

Most of the ore produced in Mohave County is of milling grade and yields bullion or concentrates. There were 198,456 tons of ore treated by amalgamation or cyanidation, which produced $2,836,597 in gold and 93,793 ounces of silver, having a total value of $2,938,831, or an average of $14.81 a ton. The concentrating ores (1,554 tons) produced 219 tons of concentrates, against 10,145 tons of ore and 596 tons of concentrates in 1919. The concentrates in 1920 had a total value of $18,257, or an average of $83.36 a ton. Crude ore shipped to smelters amounted to 2,748 tons, against 2,371 tons in 1919. In 1920 shipping ore had a total value of $119,349, or an average of $43.43 a ton.

Bentley district.—The Bentley district is reached by way of St. Thomas, Nev., its post office and point for supplies. The only production reported in 1920 consisted of copper ore containing a small quantity of silver from the Bronzell property.

Cedar Valley district.—The Newby Mines Co., operating the Antler group, shipped considerable copper ore, containing silver and a little gold, and the Diamond Joe and Silver Trails claims yielded small lots of lead ore, containing silver and a little copper.

Gold Basin district.—Gold ore from the Cyclopic property, which was operated for three months, yielded some bullion recovered by cyanidation.

Greenwood district.—The principal output of the Greenwood district was reported from the McCracken property, which produced lead ore of milling grade treated in a 100-ton dry concentrator.

Hackberry district.—None of the mines in the Hackberry district were active in 1920, and only a few small lots of ore, containing silver and gold, were shipped by lessees.

Maynard district.—Preparations to operate the Dean and Atlantic properties were made during 1920. A small test lot of silver ore, containing a little copper, was shipped to the smelter. The Prohibition group was developed five months by the owners and produced a small lot of silver ore, containing some gold.

Owens district.—Some old tailing from the Peabody mine, near Signal, that contained silver, was re-treated by cyanidation.

San Francisco district (Oatman and Goldroad).—The two largest producers in the San Francisco district are the United Eastern and Tom Reed mines. Ore from these mines and small lots of gold ore from the Gold Road, Green Quartz, and Thumb Butte properties amounted to 197,629 tons, which produced bullion containing $2,830,731 in gold and 92,806 ounces of silver, valued in all at $2,931,890, or $14.83 a ton. All the ore, except one small lot which was shipped to a smelter, was treated by cyanidation.

The United Eastern mine [13] produced 102,926 tons of ore, against 97,325 tons in 1919. Mining operations were handicapped by labor shortage from May to September, which caused a marked reduction in output for those months. In 1920 the gold recovered by cyanidation was valued at $2,093,230.38, and the silver at $80,683.90. The tailing from the ore treated contained 3,061.26 ounces of gold, valued at $63,280.89, and 2,273.13 ounces of silver, valued at $2,516.23, a total loss of $65,797.12, or 63.9 cents a ton. The total value of the gold and silver contained in the ore was $2,233,819, or $21.70 a ton. Mining costs averaged $5.19 a ton and direct milling costs $2.02 a ton, which, with costs of shaft sinking, marketing, and indirect costs, brought the total cost to $9.025. The net income from operations in 1920 was $11.90 a ton, or $1,225,761. Dividends paid since 1917 amounted to $3,134,900, of which $981,360 was paid in 1920. According to the company's annual report, the ore mined in 1920 from the United Eastern was in excess of that developed. All the ore mined and milled came from a vein in the Tom Reed Extension claim. Diamond drilling was done to determine quickly the possibilities of the vein in the next 200 or 300 feet below the bottom or tenth level. The vein material encountered did not show commercial tenor. Further drilling was under way at the end of the year.

From the Tom Reed mine [14] 93,970 tons of ore was mined, which was milled in its cyanidation plant. According to the company's printed report the gold and silver recovered during its fiscal year was valued at $705,657.48, with direct production expenses amounting to $533,313.73. The net result of the year's operations was a deficit amounting to $31,277.98. The average value of the ore milled was $7.90, and the total cost for mining, milling, and other expenses was $6.71 a ton. Most of the ore mined was by the "cut and fill" system.

[13] United Eastern Mining Co. Ann. Rept. for year ending Dec. 31, 1920.
[14] Tom Reed Gold Mines Co. Thirteenth Ann. Rept., for year ending April 1, 1921.

The Aztec mine was operated principally on its 400 and 500 levels, and the 700 level was finally cleared of water.

Wallapai district (Chloride and Kingman).—Fifteen producers in the Wallapai district reported an output of 2,399 tons of ore, containing $14,115 in gold, 37,500 ounces of silver, 11,160 pounds of copper, and 338,623 pounds of lead, valued in all at $84,133, or $35.07 a ton. Most of the output, or 1,785 tons, was shipped directly to smelters and contained 651.11 ounces of gold, 36.293 ounces of silver, 10,800 pounds of copper, and 314,523 pounds of lead. The milling ore amounted to 600 tons and produced some concentrate, which contained lead, silver, gold, and a little copper. The Kingman Consolidated led in production of lead-silver ore, followed by an output of gold-silver ore from the Dardanelles mine. Smaller lots of ore were also shipped from the Empire & Silver Union, Golden Star, Distaff, Kingman Zinc, Home Pastime, Metallic Accident, George Washington, and Rainbow properties. Several lots of silver ore were shipped from the Juno property.

Weaver district.—A small lot of silver ore was shipped to the smelter from the Silver Mountain group in 1920.

PIMA COUNTY.

Mine production in Pima County, Ariz., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	29	1,652,324	$1,447	40,655	43,808,491	489,886	$8,221,324
1920	36	1,777,309	[a] 4,699	[a] 36,147	44,854,649	209,989	8,314,153
Increase or decrease, 1920	+7	+124,985	+3,252	−4,508	+1,046,158	−279,897	+92,829

[a] Includes placer production.

Silver and lead decreased in value in 1920, and gold and copper increased. No zinc was reported in 1920. The increase in the output of copper from the low-grade disseminated ores produced in the Ajo district was small. Ore of shipping grade aggregated 37,056 tons, valued at $955,841, or $25.79 a ton. At milling plants 10,811 tons of ore yielded 1,297 tons of concentrates, containing gold, silver, and copper, valued in all at $78,510, or $60.53 a ton.

Ajo district.—All the output of the Ajo district—1,743,439 tons of copper ore—was that of the New Cornelia mine. The leaching plant and the so-called open-pit mine on this property were operated throughout the year. The experimental concentrator was operated only in January and February, and the underground mine during January and part of February. Altogether 40,104,493 pounds of copper was produced from the ore of the New Cornelia mine.[15] Of this quantity, 37,331,586 pounds was electrolytic copper, 2,113,985 pounds was contained in cement copper shipped, 249,353 pounds in ore shipped, and 409,569 pounds in concentrate shipped. The annual report contains the following notes:

[15] New Cornelia Copper Co. Ann. Rept. for year ending Dec. 31, 1920.

Deliveries of copper during the year amounted to 34,146,769 pounds, for which an average price of 18.56 cents per pound was received. * * *

On account of high freight rates and low price of copper, shipment of high-grade ore to the Calumet & Arizona smelter at Douglas became unprofitable and was discontinued in the month of January, 1920.

The only noteworthy change in the process at Ajo has been the success in returning a large proportion of the cement copper to the solution, reducing some of the ferric iron in solution to ferrous iron and recovering the copper again as electrolytic copper. While the agitators for mixing the cement copper with the solutions were in place they did not work satisfactorily until early in 1920. Since then they have been most successful. The solution has been improved, and a much greater proportion of the total copper from the leaching plant has been recovered as electrolytic copper. In 1920 only 7 per cent of the copper from the leaching plant was in the form of cement copper, as compared with 17.7 per cent in 1919 and 25.8 per cent in 1918. The production of electrolytic copper in the month of May was 3,613,985 pounds, or about 400,000 pounds more than the previous high record. Since the cost of producing electrolytic copper is nearly 3 cents per pound less than that of cement copper, a great saving was effected by this operation. * * *

The experimental flotation mill was closed down at the end of February, after a successful six months' run. During the last two months an effort was made to make the concentrates as nearly self-fluxing as possible. It was proved that very little flux need be added and that therefore the concentrates can be smelted economically at Ajo. * * *

Amole district.—The Ivy May, Old Mission, and Arizona properties were producers of ore. The Arizona-Tucson Copper Co., operating the Ivy May property, shipped three carloads of high-grade copper ore containing gold in 1920. Several mines are described in a recent report[16] on the district.

Arivaca district.—Three small lots of ore were shipped from as many properties in the Arivaca district in 1920. The ore contained lead and a little silver.

Cerro Colorado district.—One lot of lead ore, containing silver and copper, was shipped from the Cerro Colorado property in 1920.

Empire district (*Pantano*).—The Forty-nine and Chief properties were the only active mines in the Empire district. Each produced lead ore containing silver and a little copper.

Greaterville district.—An estimate of $1,226 was placed on the output of placer gold and silver from the Greaterville and outlying districts traded to merchants for supplies. Most of the output was recovered by Mexicans.

Helvetia district.—All the ore produced from six properties in the Helvetia district, amounting to 2,516 tons, was of shipping grade and contained $8 in gold, 6,295 ounces of silver, 401,244 pounds of copper, and 3,618 pounds of lead, valued in all at $80,988, or $32.19 a ton. Most of the ore containing copper was mined from shallow shafts on the Rosemont property, and smaller quantities were produced from the Narragansett and Omega mines. A small lot of oxidized lead ore was shipped from the Silver Spur claim.

Papago district.—Some pay ore was developed in the 100-foot inclined shaft of the Paradox claim, and a small lot that contained copper and silver was shipped to the smelter.

Pima district (*Twin Buttes district*).—Altogether 6,532 tons of ore was produced in the Pima district, containing $651 in gold, 18,534 ounces of silver, 950,948 pounds of copper, and 69,527 pounds of lead,

[16] A geological reconnaissance of the Tucson and Amole mountains: Bur. Mines Bull. 106, Tucson, Ariz., 1920.

valued in all at $201,389, or $30.83 a ton. Of the 13 producers, the Midland Copper Co., operating the Queen mine opened by a 600-foot shaft, was the largest shipper. Some lead ore was produced from the San Xavier, Contention, Alpha, and Olivett properties.

Silver Bell district.—The El Tiro and Imperial properties were the principal producers. The greater part of 24,528 tons, representing the district output, was copper ore mined from the El Tiro property, which operated the entire year.

PINAL COUNTY.

Mine production in Pinal County, Ariz., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.	Silver.	Copper.	Lead.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	
1919	28	2,029,526	$112,093	592,531	63,676,619	1,314,836	$12,689,265
1920	30	1,831,676	107,006	432,283	57,070,320	129,254	11,089,473
Increase or decrease, 1920	+2	−197,850	−5,087	−160,248	−6,606,299	−1,185,582	−1,599,792

Most of the ore produced in Pinal County came from the mines at Ray. Nearly all of it, or 1,816,731 tons, was of concentrating grade and produced 159,876 tons of concentrates, most of which was copper concentrate. Only a small quantity of siliceous concentrate and copper-lead concentrate was shipped. The ores of smelting grade aggregated 14,870 tons. No placer bullion was reported in 1920.

Bunker Hill district.—The Magma Chief Copper Co., operating the Jewel group, shipped several car lots of copper ore containing a little silver. Some lead ore was also shipped from the Turquoise property. The total output of the district was valued at $19,473, or an average of $63.64 a ton.

Butte district (Florence).—Ore containing copper was mined and shipped from the Mineral Butte group.

Casa Grande district.—Two small lots of ore, one of copper and the other of lead, both containing silver, were shipped from the Casa Grande district in 1920.

Goldfields district.—A small quantity of gold ore was shipped to the smelter from the Buckhorn & Boulder property.

Mineral Creek district (Ray and Kelvin).—The output of the Mineral Creek district amounted to 1,725,277 tons, most of it from two mines whose output was treated in concentration mills at Hayden and Ray. Lead ore containing silver was shipped from the Ray Silver-Lead property, and small shipments of copper ore were made from the Ray Verde and Silver Leaf properties.

The Ray Consolidated mines[17] continued production on a curtailed basis and shipped to the mill at Hayden 1,728,639 tons of concentrating ore, averaging 1.72 per cent of copper. In addition, 3,702 tons of ore, averaging 6.65 per cent of copper, was shipped to the smelter. In 1919 the milling ore amounted to 1,648,174 tons and averaged 1.83 per cent of copper. The net output of copper from all

[17] Ray Consolidated Copper Co. Twelfth Ann. Rept., for year ending Dec. 31, 1920.

sources in 1920, after allowing smelter deductions, was 47,062,030 pounds, against 46,011,371 pounds in 1919. The average operating cost per pound of net copper produced from milling and direct smelting ore for the year was 16.144 cents. By crediting the value of gold and silver and miscellaneous income the cost is reduced to 15.565 cents, as compared with 14.94 cents for 1919. Dividends of $184,596.66 and capital distributions of $1,392,582.34 gave a total of $1,577,179 distributed to stockholders. Since the inception of operations $25,412,620.67 has been paid.

Old Hat district (*Oracle and Schultz*).—The Dripping Springs Copper Co., operating the Columbia group, shipped low-grade copper ore containing a little silver.

Pioneer district.—Eleven properties in the Pioneer district produced 104,657 tons of ore, valued at $2,196,534, or an average of $20.99 a ton. The larger part of the ore was treated in concentration mills and yielded copper concentrates containing silver, and 9,414 tons of ore, containing copper, silver, gold, and a little lead, was shipped to smelters. The largest producer of copper was the Magma mine. Silver concentrates, containing copper and lead, were recovered from ore treated in the milling plant of the Silver King mine. A number of car lots of silver ore were also shipped from the old Pioneer group and lead-silver ore from the Manifest mine dump.

Curtailed operations at the Magma mine resulted in less copper but a greater output of ore hoisted. There was 100,872 tons of ore mined, which averaged 4.928 per cent of copper and 3.412 ounces of silver and 0.0438 ounce of gold a ton. Of this output, 9,219 tons of hand-sorted product was shipped directly to the smelter. It averaged 17.105 per cent of copper and 8.389 ounces of silver and 0.1104 ounce of gold to the ton. The milled ore amounted to 91,653 tons, averaging 3.704 per cent of copper and 2.91 ounces of silver and 0.0372 ounce of gold to the ton. From this ore 31,199 tons of concentrate was saved, averaging 10.14 per cent of copper and 7.753 ounces of silver and 0.1096 ounce of gold to the ton. The net production, after deducting all smelting and refining losses, was 8,854,917 pounds of copper, 303,257.55 ounces of silver, and 4,437.49 ounces of gold. On the 2,000-foot level, the deepest level of the Magma mine, a crosscut driven into the vein passed through 28 feet of ore assaying 9.98 per cent of copper and 3.9 ounces of silver and 0.035 ounce of gold to the ton. The predominating minerals in the vein at this level are bornite and chalcopyrite, which have characterized the vein for the last 1,000 feet in depth. The company owns the railroad line 31 miles long between Superior and Magma Junction, on the Arizona & Eastern Railroad. The property formerly controlled by Superior Arizona Copper Co. is now a part of the Magma group.

Priorwood district.—Important developments on the Antelope Peak property, which has a shaft 430 feet deep with 1,800 feet of drifts, have opened about 15,000 tons of ore, according to the report of the company. Several lots of copper ore, containing a little silver, were shipped to the smelter before the mine closed in October.

Riverside district.—Gold ore was opened by the Gila Development Co. on the Cane Springs group. Some experimental tests were made in a Lane mill, and gold bullion was shipped.

Saddle Mountain district.—Three producers in the Saddle Mountain district reported 344 tons of ore, containing silver and a little copper and gold, valued at $19,647, or $57.11 a ton. Most of the ore was of shipping grade and was mined from the old Odell property, operated by the Adjust Mining Co. The Little Treasure mine yielded silver ore of shipping grade mined from an adit 180 feet long.

Summit district (Bellevue).—The Fuhrmann group was operated and produced a small quantity of copper ore of shipping grade.

SANTA CRUZ COUNTY.

Twenty-six producers in Santa Cruz County reported 11,617 tons of ore in 1920, or 13,184 tons less than was reported by 23 producers in 1919. Ore of shipping grade amounted to 8,430 tons, valued at $358,854, or $42.57 a ton. At milling plants 403 tons of lead concentrate containing silver and copper was made, valued at $21,861, or $54.24 a ton.

Harshaw district.—Seven producers in the Harshaw district mined 2,814 tons of ore, of which 1,612 tons was of milling grade and produced lead concentrates containing silver and a little copper, and 1,202 tons was lead ore of shipping grade containing silver. The principal part of the output came from the Flux mine, and considerable shipping ore was from the Hardshell and Black Eagle properties. Other producers were the Blue Nose, California, and Trench. The total value of the district output was $78,284, or $27.82 a ton.

Nogales district.—Three producers operating prospects in the Nogales district made small shipments of copper and lead ores to the smelters.

Palmetto district.—Development work by diamond drilling was done on the property of the Patagonia Superior Copper Co. during 1920. The results were not encouraging, and all work was stopped in November.

Patagonia district.—Twelve producers in the Patagonia district reported the output of 8,550 tons of ore and old tailings, containing $440 in gold, 70,607 ounces of silver, 836,331 pounds of copper, and 960,408 pounds of lead, valued in all at $308,120. The ore shipped amounted to 6,975 tons and contained 21.30 ounces of gold, 60,964 ounces of silver, 778,263 pounds of copper, and 960,408 pounds of lead. The old tailings treated contained copper and silver. Lessees were in charge of the Duquesne property and made shipments of considerable copper ore and copper-lead ore and also re-treated some of the old tailing from former milling operations. The Pride of the West group was operated by lessees and produced some copper-silver ore of shipping grade. From the Mowry mine shipments of lead carbonate to the smelter continued during the entire year. Other shippers were the Gladstone, Thessalia, Tres de Mayo, Southern Copper, Paloma, and Prudential properties.

Tyndall district.—The Royal Blue, Bland, and Isabella properties produced 196 tons of shipping ore, containing gold, silver, copper, and lead, valued at $12,639, or $64.48 a ton.

Wrightson district.—Lead ore containing silver was shipped to the smelter from the Blue-Lead group in 1920.

YAVAPAI COUNTY.

Mine production in Yavapai County, Ariz., in 1919 and 1920.

Year.	Number of producers.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Recoverable zinc.	Total value.
		Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	79	738,221	$614,968	1,252,894	80,227,549	237,605	1,717,000	$17,078,467
1920	73	1,038,243	659,541	1,555,075	114,937,080	238,296	1,457,296	23,640,101
Increase or decrease, 1920	— 6	+ 300,022	+ 44,573	+ 302,181	+ 34,709,531	+ 691	— 259,704	+6,561,634

[a] Includes placer production.

Of the total value of the metals reported, $659,541 was for gold, $1,695,032 for silver, $21,148,423 for copper, $19,064 for lead, and $118,041 for zinc. Most of the first-class ore shipped to smelters consisted of copper ores (896,630 tons, of which 895,753 tons was sulphide ore and 877 tons oxidized copper ore). The average value of the smelting ores was $24.37 a ton. Concentrates amounting to 34,859 tons, derived from 121,959 tons of ore, were valued at $1,173,522, or $33.66 a ton. The placer output amounted to $3,145 in gold and 4 ounces of silver, against $2,083 in gold and 16 ounces of silver in 1919.

Agua Fria district.—Two producers, the Binghampton and Franco American properties, reported the production of copper ore amounting to 26,861 tons. With the exception of 29 tons, all this ore was treated in a 250-ton flotation mill on the Binghampton property. This mine is opened by a 1,200-foot vertical shaft. The concentrate was shipped to the smelter at Humboldt.

Big Bug district.—Seventeen producers reported 116,184 tons of ore, including 771 tons of old tailings, containing $121,833 in gold, 182,495 ounces of silver, 5,016,344 pounds of copper, and 144,999 pounds of lead, valued in all at $1,255,360, or $10.80 a ton. A small quantity of gold bullion was reported by one placer operator. The bulk of the ore, or 75,193 tons, was milled and produced 24,317 tons of copper concentrate and lead concentrate containing silver and gold. The ore of shipping grade, amounted to 40,220 tons and contained 3,455.70 ounces of gold, 103,170 ounces of silver, 2,294,536 pounds of copper, and 62,883 pounds of lead. The principal part of the ore produced was mined from the Blue Bell property, and its copper and silver content was recovered from the concentrates smelted at the plant of the Consolidated Arizona Smelting Co., at Humboldt. The largest production of lead ore, containing silver and a little copper, came from the Arizona National property. Large shipments of lead ore were also made from the Silver Belt and three other claims in the vicinity. Other producers of ore were the Gladstone & McCabe, Kit Carson, Walter, and Silver Buck claims.

Black Canyon district.—Two car lots of silver ore were produced from the Brooks and Cutter claims and shipped to smelters.

Black Hills district.—During development work one lot of copper sulphide ore containing some silver was shipped from the Yaeger

Canyon property, owned by the Shannon Copper Co. The inclined shaft on this property is sunk 1,300 feet.

Black Rock district (*Constellation*).—Very little development work was done in the Black Rock district, and only two producers reported the output of some gold ore and copper-lead ore.

Copper Basin district.—The Phelps Dodge property in the Copper Basin district was operated by lessees, who produced some copper ore, containing silver and a little gold.

Eureka district (*Hillside*).—Zinc ore from the Copper King property, operated by the Arizona Hillside Development Co., was shipped to eastern zinc smelters.

Hassayampa district.—Seven producers in the Hassayampa district reported the output of 1,170 tons of ore, containing $5,102 in gold, 12,112 ounces of silver, 11,915 pounds of copper, and 14,474 pounds of lead, valued in all at $21,654, or $18.51 a ton. Most of the ore (845 tons), was treated at milling plants, producing gold bullion and some concentrates, and 325 tons was shipped directly to the smelter. The largest producer of silver-gold ore, containing copper, was the Monte Cristo mine, and several lots of copper ore were shipped from the McNulty & McBride property. Other producers were the Climax, Dosoris, and Bona group. The ore from the Monte Cristo mine was treated in a flotation plant, which, with the mine, was operated 10 months.

Martinez district.—Lessees cleaning up the old works of the Congress mine shipped to the smelter some concentrate and crude ore, containing gold, silver, and a little copper.

Peck district.—The De Soto and Swastika mines were the largest producers of copper ore in the Peck district. Nearly all the output came from the De Soto and was shipped to the Consolidated Arizona works at Humboldt and there concentrated. Considerable silver ore, containing a little copper and gold, was shipped to the smelter from the Swastika mine. A 50-ton cyanide mill was under construction at this property in 1920. The Peck mine was under lease and produced a little silver-lead ore. The total output of the district amounted to 20,316 tons, valued at $191,062.

Pierce district.—The Pierce district is 12 miles northwest of Aguila. One of the Bullard properties, known as Bullard's Home mine, is in this district and should not be confused with other properties of the same name in the Cunningham Pass district. Lessees operated about two months on this property and shipped considerable oxidized copper ore, containing gold.

Pine Grove district.—Four producers in the Pine Grove district reported the output of 188 tons of ore of shipping grade, containing $850 in gold, 6,359 ounces of silver, and 12,429 pounds of copper, valued in all at $10,068, or $53.55 a ton. Most of the copper ore came from the Union mine. Small lots of silver ore were shipped from the Blue Jacket, McKay-Randolph, and a property operated by Norris & Libby.

Thumb Butte district.—A small lot of lead ore containing silver was shipped directly to the smelter from the Dearing group.

Tiger district (*Crownking*).—The ore produced in the district amounted to 144 tons of shipping ore, valued at $5,553. Most of the output was silver ore from the Cougar claim.

Turkey district (*Venezia*).—Nine producers reported an output of 221 tons of ore valued at $11,641, or $52.67 a ton. Most of it was smelting ore, containing gold and silver. The Black Canyon property was under development the entire year, and a small quantity of ore was treated in the L. T. S. mill, near by. Other producers were the Bill Arp, War Eagle, Silver Cross, Turkey Creek Silver, and Silver Zone properties.

Verde district (*Jerome*).—From the operations of four producers in the Verde district 870,129 tons of ore was smelted. The recovered bullion was valued at $21,597,163 and contained $503,599 in gold, 1,275,323 ounces of silver, and 107,084,032 pounds of copper. The largest part of the ore output came from the United Verde mine, followed by the United Verde Extension, Jerome Verde, and Shea Copper Co. At the United Verde mine a steam shovel was operating over the old fire district, removing the overburden and slag dump. The object of this work is to reach the high grade as well as the low-grade ores that are said to be sealed within that part of the mine.

The United Verde Co.[18] reported employing approximately 60 per cent as many men as during the peak of war production and turning out about 40 per cent as much copper.

The ore from the United Verde Extension mine[19] is hauled to the smelter at Clemenceau, in the valley below Jerome. Altogether 161,617 dry tons of ore was mined and smelted, which produced 41,942,700 pounds of copper, 5,530 ounces of gold, and 359,370 ounces of silver, valued at $7,591,814.22. Dividends paid in 1920 amounted to 2,100,000. The cost of producing copper amounted to 8.53 cents a pound, which does not include deductions for depreciation, depletion, or taxes. Although the property is developed to the 1,700-foot level, which has a showing of low-grade disseminated ore in one of the drifts, no work will be done below the 1,400-foot level until there is an advance in the price of copper. The estimated ore reserves above the 1,500-foot level amount to 1,148,800 tons, averaging 11.81 per cent of copper and 0.023 ounce of gold and 2.22 ounces of silver to the ton.

Walker district.—One small lot of silver ore, containing gold, was shipped to the smelter from the Blue John mine. This property has a vertical shaft 100 feet deep and 200 feet of drifts.

Walnut Grove district (*Kirkland*).—A prospect in the Walnut Grove district produced a small quantity of gold ore.

YUMA COUNTY.

The total value of the gold, silver, copper, and lead produced in Yuma County was $694,274, against $221,639 in 1919. No placer production was reported.

Castle Dome district (*Dome*).—Two producers of lead ore and concentrates in the Castle Dome district yielded 4,760 ounces of silver, a little copper, and 379,801 pounds of lead, valued at $35,677. The output came principally from the property of the Reorganized United Mines Co. Several small lots of ore shipped from the Sonora

[18] Min. and Sci. Press, vol. 121, p. 811, Dec. 4, 1920.
[19] United Verde Extension Mining Co. Ann. Rept. for year ending Dec. 31, 1920.

property carried as high as 57 per cent of lead and 22 ounces of silver to the ton.

Cienega district.—Very little activity was reported in the Cienega district, and the only production was copper ore from the Rincon property.

Ellsworth district.—The largest producer of the Ellsworth district was the Critic mine, which yields a high grade copper ore containing gold. According to the printed statement of the company, the Critic mine produced 167 tons of ore, containing 65.86 ounces of silver and 40,995 pounds of copper, valued at $9,086.75. One lot of copper ore was shipped from the Orezona mine.

Planet district.—The Swansea mine, operated by lessees, produced a large quantity of copper ore, most of which was milled. Concentrates and first-class ore were shipped to the Humboldt smelter.

Plomosa district.—Three small lots of ore shipped from the Plomosa district had a total value of $5,415. Most of the ore contained gold and one lot contained considerable copper.

Silver district.—One small lot of lead ore, containing silver, was shipped from the Saxon property.

IRON ORE, PIG IRON, AND STEEL.[1]

By Ernest F. Burchard and Hubert W. Davis.

INTRODUCTION.

The iron industry, so far as is indicated by records of output, was more active in 1920 than in 1919, prices were higher, and the volume of business transacted was much greater, but notwithstanding the considerable activity conditions were not generally satisfactory.

Urgent necessity brought about by the underbuilt and undersupplied condition of the country due to the wastage of the war underlay the demand that existed for iron and steel in 1920, but in view of the obstacles with which producers of iron ore and metal had to contend it appears remarkable that production was so great. Ore shipments were hindered by a strike of ore handlers at the shipping docks early in the season, then by railroad tie-ups, due to a strike of switchmen, and by a shortage of coal, cars, and vessels, and later by the closing down of blast furnaces. The switchmen's strike and the scarcity of fuel likewise affected the output of pig iron and steel.

Prices of steel products advanced steadily for four to six months, and two standards of prices were current, the higher for prompt deliveries. The buying of steel by automobile manufacturers was the most active feature of the market during the first half of the year and probably caused prices of steel to reach levels that brought on a buyers' strike a little later. At any rate demand, which must have been far from satisfied, slackened notably during the later part of 1920, especially during the last three months, and the year closed with many companies operating only a small part of their mining or manufacturing capacity and facing but little prospective business.

IRON ORE.

QUANTITIES MINED AND SHIPPED IN 1920.

The iron ore mined in the United States in 1920, exclusive of that containing 5 per cent or more of manganese,[2] is shown in the accompanying table, which includes beneficiated ore, instead of crude ore mined, if the ore is treated in any way. The quantities of ore, both mined and shipped, stated in the tables, include the iron ore used for fluxing other metallic ores at smelters in the Western States, but the shipments do not include the iron ore sold for the manufacture of

[1] The statistics of imports and exports in this chapter were compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

[2] The production of manganiferous iron ore is stated in the chapter on manganese and manganiferous ores in Mineral Resources for 1920.

paint, which amounted in 1920 to 24,448 gross tons, valued at $112,364, or $4.60 a ton, compared with 15,969 tons, valued at $84,630, or $5.30 a ton, in 1919. In Arkansas one producer shipped a small quantity of loadstone, averaging about 70 per cent of metallic iron, which was sold at a high price to chemical and novelty manufacturers. This shipment is not included in the tabulated statistics of iron ore.

Iron ore was mined in 25 States in 1920, as compared with 24 States in 1919, Texas having dropped out and Arizona and Nevada having been added as producers in 1920. Of these States Idaho, Montana, and Utah produced iron ore for flux only; part of the production of California, Michigan, and Missouri was used for flux; a small quantity of ore from Virginia was used in the manufacture of hydrogen gas; some of the ore from Pennsylvania was used for gas purification; the remaining States produced iron ore mainly for use in blast furnaces, except small quantities used for paint from California, Georgia, Maryland, Michigan, Nevada, New Jersey, New York, Pennsylvania, Tennessee, and Wisconsin. The rank of the three States producing the largest quantity of iron ore—Minnesota, Michigan, Alabama—remained practically unchanged in 1920. The Minnesota iron ranges are producing more iron ore than all the rest of the States together, having furnished between 58 and 60 per cent of the total for the United States in recent years.

The ores of iron are generally classed under the four heads hematite, brown ore, magnetite, and carbonate.[3]

Iron ore mined in the United States in 1919 and 1920, by States and varieties, in gross tons, with percentage of increase or decrease in 1920.

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total quantity.	Percentage of increase or decrease in 1920.
1919.						
Alabama	4,444,213	608,822	.....	.....	5,053,035	
California	.....	.....	2,053	.....	2,053	
Connecticut	.....	5,384	.....	.....	5,384	
Georgia	.....	71,224	.....	.....	71,224	
Idaho	.....	[a]1,838	.....	.....	[a]1,838	
Maryland	357	.....	.....	.....	357	
Massachusetts	.....	9,509	.....	.....	9,509	
Michigan	15,438,930	.....	.....	.....	15,438,930	
Minnesota	36,000,626	.....	.....	.....	36,000,626	
Missouri	44,867	8,989	.....	.....	53,856	
Montana	.....	2,238	1,200	.....	3,438	
New Jersey	.....	.....	404,428	.....	404,428	
New Mexico	[b]27,928	.....	[b]197,111	.....	225,039	
New York	44,150	.....	827,345	.....	871,495	
North Carolina	.....	15,295	43,483	.....	58,778	
Pennsylvania	.....	10,268	616,899	.....	627,167	
Tennessee	179,370	104,422	.....	.....	283,792	
Utah	.....	21,015	23,170	.....	44,185	
Virginia	53,281	251,815	.....	.....	305,096	
Wisconsin	1,087,247	.....	.....	.....	1,087,247	
Wyoming	398,613	.....	.....	.....	398,613	
Other States [c]	.....	16,578	2,750	.....	19,328	
	[b]57,719,582	[a]1,127,397	[b]2,118,439	.....	[a]60,965,418	

[a] Revised figures.
[b] Some magnetite included with hematite.
[c] Colorado, Texas, and Washington.

[3] Notes concerning the composition of these types of ores are given in U. S. Geol. Survey Mineral Resources, 1916, pt. 1, pp. 537-541, 1918.

Iron ore mined in the United States in 1919 and 1920, by States and varieties, in gross tons, with percentage of increase or decrease in 1920.—Continued.

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total quantity.	Percentage of increase or decrease in 1920.
1920.						
Alabama	5,169,782	724,229	.....	.....	5,894,011	+ 17
Arizona	.....	.....	950	.....	950	
California	.....	1,094	5,573	.....	6,667	+225
Colorado	.....	1,914	.....	.....	1,914	− 55
Connecticut	.....	3,700	.....	.....	3,700	− 31
Georgia	38,794	65,717	.....	.....	104,511	+ 47
Idaho	.....	275	.....	.....	275	− 85
Maryland	304	800	.....	.....	1,104	+209
Massachusetts	.....	6,639	.....	.....	6,639	− 30
Michigan	17,510,742	.....	.....	.....	17,510,742	+ 13
Minnesota	39,453,173	.....	.....	.....	39,453,173	+ 10
Missouri	42,754	12,240	.....	.....	54,994	+ 2
Montana	1,142	1,573	8,088	.....	10,803	+214
Nevada	.....	238	.....	.....	238	
New Jersey	.....	.....	431,567	.....	431,567	+ 7
New Mexico	[a] 19,359	.....	[a] 254,860	.....	274,219	+ 22
New York	21,621	.....	898,388	.....	920,009	+ 6
North Carolina	.....	27,328	44,482	.....	71,810	+ 22
Pennsylvania	.....	1,892	728,751	3,740	734,383	+ 17
Tennessee	167,066	208,472	.....	.....	375,538	+ 32
Utah	(b)	[b] 19,777	16,382	.....	36,159	− 18
Virginia	71,151	249,773	.....	.....	320,924	+ 5
Washington	.....	.....	2,500	.....	2,500	− 9
Wisconsin	981,134	.....	.....	.....	981,134	− 10
Wyoming	406,501	.....	.....	.....	406,501	+ 2
	[a b] 63,883,523	[b] 1,325,661	[a] 2,391,541	3,740	67,604,465	+ 11

[a] Some magnetite included with hematite. [b] Some hematite included with brown ore.

Iron ore shipped from mines in the United States, 1919 and 1920, by States.

State.	1919		1920					
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Increase or decrease.		Percentage of increase or decrease.	
					Quantity (gross tons).	Value.	Quantity.	Value.
Alabama	4,895,309	$11,954,425	5,833,317	$15,993,985	+ 938,008	+$4,039,560	+ 19	+ 34
California	2,053	13,796	6,592	44,844	+ 4,539	+ 31,048	+ 221	+225
Georgia	74,007	294,619	104,482	460,633	+ 30,475	+ 166,014	+ 41	+ 56
Michigan	12,911,727	49,774,212	18,862,578	85,749,217	+ 5,950,851	+35,975,005	+ 46	+ 72
Minnesota	34,547,356	121,107,247	39,747,594	163,538,054	+ 5,200,238	+42,430,807	+ 15	+ 35
Missouri	53,626	223,144	50,825	230,827	− 2,801	+ 7,683	− 5	+ 3
Montana	(a)	(a)	10,803	73,889	(b)	(b)	(b)	(b)
New Jersey	336,629	1,712,255	417,100	2,595,949	+ 80,471	+ 883,694	+ 24	+ 52
New Mexico	224,553	506,538	274,705	547,370	+ 50,152	+ 40,832	+ 22	+ 8
New York	701,688	4,002,312	959,408	6,263,252	+ 257,720	+ 2,260,940	+ 37	+ 56
North Carolina	58,778	231,530	71,810	293,382	+ 13,032	+ 61,852	+ 22	+ 27
Pennsylvania	616,271	1,340,219	719,813	1,406,929	+ 103,542	+ 66,710	+ 17	+ 5
Tennessee	282,988	817,549	373,012	1,355,217	+ 90,024	+ 537,668	+ 32	+ 66
Utah	44,185	177,327	36,159	151,174	− 8,026	− 26,153	− 18	− 15
Virginia	304,920	1,139,349	320,109	1,227,601	+ 15,189	+ 88,252	+ 5	+ 8
Wisconsin	881,740	3,253,290	1,067,159	4,333,307	+ 185,419	+ 1,080,017	+ 21	+ 33
Other States [c]	[d] 436,954	[d] 764,705	425,875	740,697	− [b] 276	+ [b] 49,881	−[b] .06	+ [b] 7
	[d] 56,372,784	[d]197,312,517	69,281,341	285,006,327	+12,908,557	+87,693,810	+ 23	+ 44

[a] Less than three shippers in Montana in 1919 and permission not granted to publish State total. Figures for this State therefore included in "Other States."
[b] Increase for Montana included with "Other States."
[c] 1919: Colorado, Connecticut, Idaho, Maryland, Massachusetts, Montana, Texas, Washington, and Wyoming; 1920: Arizona, Colorado, Connecticut, Idaho, Maryland, Massachusetts, Nevada, Washington, and Wyoming.
[d] Revised figures.

The Lake Superior district, comprising Minnesota, Michigan, and northern Wisconsin, mined about 86 per cent of the total ore in 1919 and 1920. The Birmingham district, Alabama, mined 7.7 per cent of the total, or one-eleventh as much as the Lake district in 1920. The Adirondack district, New York, mined a little more than 1 per cent of the total iron ore mined.

Iron ore[a] mined in the United States, by mining districts and varieties, in 1919 and 1920, in gross tons.

1919.

District.	Hematite.	Brown ore.	Magnetite.	Total.
Lake Superior [b]	52,392,339	.....	.....	52,392,339
Birmingham	4,253,167	277,865	.....	4,531,032
Chattanooga	350,116	196,822	.....	546,938
Adirondack	.....	.....	740,315	740,315
Northern New Jersey and southeastern New York	.....	.....	491,458	491,458
Other districts	[c] 723,960	[d] 652,710	[c] 886,666	[d] 2,263,336
	[c] 57,719,582	[d] 1,127,397	[c] 2,118,439	[d] 60,965,418

1920.

District.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.	Percentage of increase in 1920.
Lake Superior [b]	57,860,530	.....	.....	.....	57,860,530	10
Birmingham	4,953,653	266,561	.....	.....	5,220,214	15
Chattanooga	393,733	187,184	.....	.....	580,917	6
Adirondack	.....	.....	783,590	.....	783,590	6
Northern New Jersey and southeastern New York	.....	.....	546,365	.....	546,365	11
Other districts	[c][e] 675,607	[e] 871,916	[c] 1,061,586	3,740	2,612,849	15
	[c][e] 63,883,523	[e] 1,325,661	[c] 2,391,541	3,740	67,604,465	11

[a] Exclusive of ore containing 5 per cent or more of manganese.
[b] Includes only those mines in Wisconsin which are in the true Lake Superior district.
[c] Some magnetite included with hematite.
[d] Revised figures.
[e] Some hematite included with brown ore.

The ore reported as sold for fluxing other than in the manufacture of pig iron amounted to 50,351 gross tons, valued at $245,117, in 1920, as compared with 78,194 tons (revised figures), valued at $225,362, in 1919. The ore reported as sold in 1920 for purifying gas and for hydrogen manufacture amounted to 2,108 gross tons, valued at $24,094, compared with 5,000 tons, valued at $43,185, in 1919. The domestic iron ore actually sold for the manufacture of pig iron amounted in 1920 to 69,228,882 gross tons, valued at $284,737,116, compared with 56,289,590 tons, valued at $197,043,970, in 1919.

A graphic comparison of the annual production of iron ore and its derived metals since 1870 is afforded by the curves shown in figure 8. It must be borne in mind, however, that the figures for the three products are not strictly comparable, because considerable foreign iron ore and also some cinder, scale, and scrap enter into the produc-

tion of domestic pig iron, and considerable quantities of scrap iron and steel, as well as cinder and scale, enter into the production of new steel.

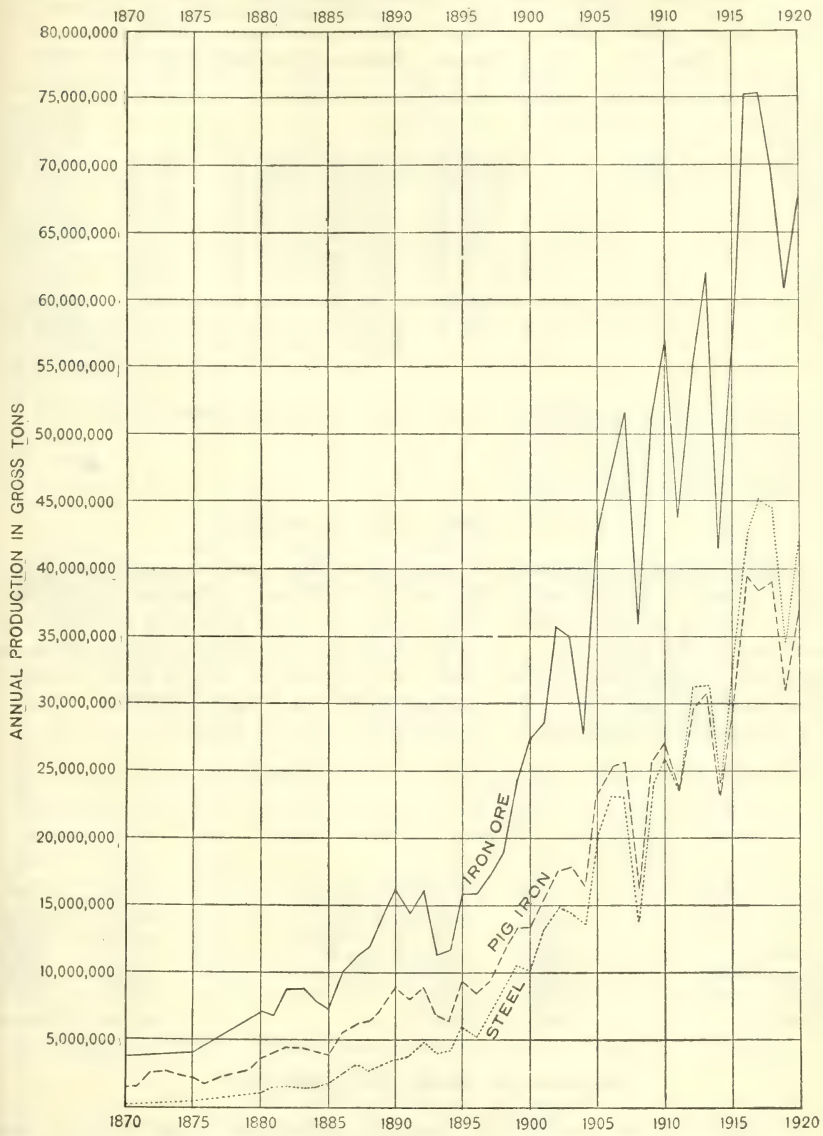


FIGURE 8.—Curve showing annual production of iron ore, pig iron, and steel in the United States, 1870–1920.

TOTAL OUTPUT OF IRON ORE.

The following table shows the production of various types of iron ore in the United States as far as it has been recorded or estimated. The figures for the years prior to 1880 are not strictly accurate,

having been calculated from the pig iron produced, which included imported ore as well as domestic ore.

Iron ore mined in the United States, 1810–1920, in gross tons.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
1810–1869					49,656,000
1870[a]–1880					51,690,889
1881–1890					103,854,386
1891–1900	136,961,046	22,815,764	14,634,364	1,065,137	175,506,311
1901–1910	364,179,432	[b]28,287,994	[b]20,664,453	262,366	413,394,245
1911	39,626,224	2,032,094	2,202,527	15,707	43,876,552
1912	51,345,782	1,614,486	2,179,533	10,346	55,150,147
1913	57,933,251	1,682,063	2,357,274	7,849	61,980,437
1914	38,286,670	1,537,750	1,610,203	5,138	41,439,761
1915	52,227,324	1,488,709	1,807,002	3,455	55,526,490
1916	70,728,024	1,904,484	2,533,364	1,800	75,167,672
1917	70,743,513	1,992,332	2,553,006		75,288,851
1918	65,894,709	1,613,844	2,149,725		69,658,278
1919	[c]57,719,582	[d]1,127,397	[c]2,118,439		[d]60,965,418
1920	[c e]63,883,523	[e]1,325,661	[c]2,391,541	3,740	67,604,465
					1,400,759,902

[a] Includes ore produced by owners of blast furnaces, estimated by census at 800,000 tons.
[b] Some brown ore included with magnetite.
[c] Some magnetite included with hematite.
[d] Revised figures.
[e] Some hematite included with brown ore.

STOCK OF IRON ORE AT MINES.

According to the reports of producers the total quantity of iron ore in stock at the mines at the end of 1920 amounted to 11,378,794 gross tons, compared with 13,097,500 tons at the end of 1919, a decrease of 13 per cent. As the quantity of ore in stock piles is necessarily partly estimated, there are variations in the mine reports from year to year which prevent an absolute balance between quantity mined and the quantity sold plus stocks on hand.

Stock of iron ore at mines, by States, Dec. 31, 1919 and 1920, in gross tons.

State.	1919	1920	State.	1919	1920
Alabama	402,647	463,341	New Jersey	267,162	269,298
California		70	New Mexico	486	
Georgia	7,042	3,885	New York	203,267	154,669
Iowa	12,165	12,165	Pennsylvania	45,500	54,400
Maryland	2,140	1,580	Tennessee		3,709
Massachusetts	3,960	1,530	Virginia	44,315	42,630
Michigan	6,874,604	5,532,368	Wisconsin	431,312	341,212
Minnesota	4,801,460	4,493,158			
Missouri	1,440	4,779		13,097,500	11,378,794

PRICES OF IRON ORE PER TON.

In the following table the average selling price per ton at the mines of the different classes of iron ore in 1919 and 1920 is given for each of the producing States or groups of States, except where there were less than three producers or shippers of a certain variety of ore in a State and permission was not given to publish the prices. These figures are taken directly from statements of the producers and probably represent only approximately the actual selling prices, as some of the reports evidently include merely mining costs; others contain,

in addition, the cost of selling and insuring the ore; in others an allowance for sinking fund is included; and in still others the figures given are the costs charged against the blast furnaces; none of them, however, include freight costs.

Average price per gross ton of iron ore at mines in the United States in 1919 and 1920.

State.	Hematite.		Brown ore.		Magnetite.	
	1919	1920	1919	1920	1919	1920
Alabama	$2.29	$2.52	$3.52	$4.26	.....	.....
California	.....	.....	.....	(a)	$6.72	$7.16
Georgia	.....	4.00	3.98	4.62	.....	.....
Michigan	3.85	4.55	.....	.....	.....	.....
Minnesota	3.51	4.11	.....	.....	.....	.....
Missouri	4.03	4.44	4.85	4.96	.....	.....
Montana	.....	(a)	(a)	8.00	(a)	6.65
New Jersey	.....	.....	(a)	(a)	5.08	6.24
New Mexico	(a)	1.90	.....	.....	(a)	(a)
New York	(a)	(a)	.....	.....	5.85	6.56
North Carolina	.....	.....	3.51	4.05	(a)	(a)
Pennsylvania	.....	.....	(a)	(a)	2.13	1.93
Tennessee	(a)	(a)	3.08	4.05	.....	.....
Utah	.....	.....	(a)	3.92	(a)	(a)
Virginia	3.84	4.27	3.71	3.73	.....	.....
Wisconsin	3.69	4.06	.....	.....	.....	.....
Other States b	1.48	1.50	c 4.34	6.48	2.58	7.46
	3.48	4.09	c 3.63	4.19	4.08	4.59

a Less than three producers and permission to publish not given; therefore price may not be shown.
b 1919: Colorado, Connecticut, Idaho, Maryland, Massachusetts, Montana, New Mexico, Texas, Utah, Washington, and Wyoming; 1920: Arizona, Colorado, Connecticut, Idaho, Maryland, Massachusetts, Nevada, Washington, and Wyoming.
c Revised figures.

Average price per gross ton of iron ore in the United States, 1906–1920.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	General average.a
1906	$2.13	$1.78	$2.05	$1.75	$2.11
1907	2.03	1.81	2.03	1.74	2.55
1908	2.32	1.70	2.40	1.38	2.27
1909	2.17	1.68	2.40	1.73	2.15
1910	2.52	1.76	2.36	1.61	2.47
1911	2.12	1.72	2.29	1.83	2.11
1912	1.87	1.79	2.18	1.96	1.88
1913	2.21	1.88	2.07	2.06	2.19
1914	1.79	1.72	2.39	2.44	1.81
1915	1.80	1.80	2.50	2.44	1.83
1916	2.32	2.03	3.11	3.00	2.34
1917	3.12	2.95	4.29	.....	3.15
1918	3.35	3.51	4.60	.....	3.39
1919	3.48	b 3.63	4.08	.....	3.50
1920	4.09	4.19	4.59	.....	4.11

a Average prices in 1889 and 1892–1905 are given in Mineral Resources for 1919 and many earlier volumes.
b Revised figures.

LAKE SUPERIOR DISTRICT.

PRODUCTION.

The total quantity of ore mined from the Lake Superior district, not including the Iron Ridge area in Wisconsin, increased 10 per cent in 1920. The output of the several ranges is shown below. All ore containing more than 5 per cent of manganese is excluded. The production of manganiferous iron ore from the Cuyuna range is reported in the chapter on manganese and manganiferous ores in

Mineral Resources. The Mesabi range produced 63 per cent of the entire output of the Lake Superior district and 54 per cent of the entire output of the United States.

Iron ore mined in the Lake Superior district, 1854–1920, in gross tons.

Year.	Marquette.	Menominee.	Gogebic.	Vermilion.	Mesabi.	Cuyuna.	Total.
1854–1870	3,971,716	.....	.....	.....	.....	.....	3,971,716
1871–1880	10,294,047	858,810	.....	.....	.....	.....	11,152,857
1881–1890	18,598,012	11,917,416	8,657,807	3,260,426	.....	.....	42,433,661
1891–1900	27,269,545	21,639,872	23,361,043	12,097,048	32,282,873	.....	116,650,381
1901–1910	37,728,143	41,974,789	34,514,899	15,350,581	194,654,902	.....	324,223,314
1911	3,743,145	4,062,778	3,099,197	1,336,938	23,126,943	181,224	35,550,225
1912	3,545,012	4,465,466	3,926,632	1,457,273	32,604,756	369,739	46,368,878
1913	3,977,808	4,997,246	4,743,515	1,536,115	36,378,671	744,007	52,377,362
1914	3,320,763	3,671,499	4,601,240	1,362,416	19,808,434	776,051	33,540,403
1915	3,817,892	4,665,465	4,996,237	1,541,645	30,802,409	1,120,606	46,944,254
1916	4,792,987	6,649,578	7,707,101	1,704,440	41,325,341	1,555,641	63,735,088
1917	4,638,374	6,366,483	7,881,232	1,481,301	41,127,323	1,986,608	63,481,321
1918	3,946,554	6,041,637	7,837,634	1,192,677	39,055,977	1,705,315	59,779,794
1919	4,158,751	4,863,968	7,368,994	1,051,795	33,262,954	1,685,877	52,392,339
1920	4,457,609	5,651,542	8,298,206	1,053,518	36,641,880	1,757,775	57,860,530
	138,260,358	127,826,549	126,993,737	44,426,173	561,072,463	11,882,843	1,010,462,123

SHIPMENTS AND RECEIPTS.

According to the Iron Trade Review, 60,410,477 gross tons of iron ore and manganiferous iron ore was shipped in 1920 from the Lake Superior district, including the Iron Ridge and Baraboo areas in Wisconsin, as compared with 48,546,651 tons in 1919. The shipments as reported to the Geological Survey in 1920 amounted to 59,677,331 gross tons, exclusive of manganiferous iron ore containing 5 per cent or more of manganese, compared with 48,340,823 tons in 1919.

The iron ore received at Lake Erie ports in 1920 amounted to 45,669,994 gross tons and at Lake Michigan ports to 11,393,184 gross tons, a total of 57,063,178 tons, compared with 37,423,585 tons at Lake Erie ports and 8,543,062 tons at Lake Michigan ports, a total of 45,966,647 tons, in 1919. Detailed figures of shipments and receipts by ports and by months for the last five years, which are omitted from this chapter, will be found in issues of the Iron Trade Review and in Mineral Resources for 1919 and many preceding volumes.

STOCKS OF IRON ORE AT LAKE ERIE PORTS.

Stocks of iron ore at lower Lake ports at the end of the shipping season are of importance on account of their bearing on the manufacture of pig iron during the following winter and spring. At the close of navigation in 1920 there was 10,930,854 gross tons of ore in stock at Lake Erie ports, compared with 10,456,314 tons at the corresponding date in 1919.[3a] At the opening of navigation, in May, 1921, there was 8,089,216 gross tons of ore in stock at these ports,[4] indicating a withdrawal of less than 3,000,000 tons during the winter of 1920–1921. The average quantity withdrawn each winter during the preceding five winters has been nearly 5,000,000 tons. Detailed statistics concerning these stocks by ports will be found in the Iron Trade Review and Marine Review and in Mineral Resources for 1919 and preceding years.

[3a] Iron Trade Review.
[4] Marine Review.

PRICES OF LAKE SUPERIOR IRON ORE.

The value of iron ore per unit of iron, in natural state, for the four standard grades of Lake Superior ore for the last 21 years is shown in the Iron Trade Review.[5] The values established February 2, 1920, are as follows: Old range Bessemer, 14.636 cents; Mesabi Bessemer, 14.182 cents; old range non-Bessemer, 14.175 cents; Mesabi non-Bessemer, 13.883 cents. The prices per ton which correspond to these unit prices are, respectively, $7.45, $7.20, $6.70, and $6.55, and are $1 higher than during the shipping season of 1919. The base for old range and Mesabi Bessemer ore is a metallic iron content of 55 per cent, natural, and for the old range and Mesabi non-Bessemer 51.5 per cent, natural. The 1920 prices are the highest on record. The lowest prices ever quoted for these ores were $2.60 for old range Bessemer in 1897, $2.15 for Mesabi Bessemer in 1895, $1.85 for old range non-Bessemer in 1898, and $1.75 for Mesabi non-Bessemer ore in the same year.

MINING DEVELOPMENTS.

Recent years have witnessed with more or less regularity a cycle of events in the labor world that have tended to handicap production of iron ore, and the year 1920 was no exception in this respect. Some of the handicaps to production of ore, such as the shortage of coal caused by strikes of miners and railroad switchmen, prove also a handicap to the industries that consume iron ore, so perhaps in the long run as much ore is produced as is really needed, and, in fact, the records of stocks at mines, at lower Lake ports, and at furnaces rarely indicate a serious shortage of ore. A greater output of ore would have been possible in 1920 had it not been for a strike of ore handlers at the shipping docks, and shortage of cars and boats due indirectly to the coal situation and to labor difficulties still further checked shipments and retarded production; finally, when all was running smoothly in the ore fields, the demand for ore slackened, owing in part to effects upon the consuming interests of similar troubles, together with buyers' strikes. Notwithstanding all these handicaps the output of iron ore in the Lake Superior district was so great as to reflect much credit upon the management of the enormous mines that make the district unique. The labor problems in this district are being handled chiefly by generous treatment of the workers and by the development of labor-saving machinery and of skilled labor to manipulate it.

LAKE SUPERIOR DISTRICT.

The leading events and features of the year are chronicled in trade and technical magazines[6] and will be only briefly summarized here.

General features.—Among the improvements that help to increase ore output are the introduction of larger, heavier, and stronger mechanical equipment in open-pit mines on the Mesabi range, such as 300-ton electrically operated shovels, 30-yard stripping cars, and 75-ton ore cars. Dirt spreaders, track shifters, and locomotive cranes for track laying eliminate many hands and do things rapidly

[5] Iron Trade Review, June 23, 1921, p. 1714.

[6] Iron Age, Jan. 6, 1921, pp. 48–50, and Jan. 13, 1921, pp. 127–129; Iron Trade Review, Jan. 6, 1921, pp. 33–44; Eng. and Min. Jour., Jan. 22, 1921, pp. 163–164, 179.

and on a large scale. Small revolving shovels with caterpillar gear are used without tracks. The use of ore loaders in underground mines, the use of concrete in shafts and shaft houses, and the increase in electrification of mines in Michigan are noteworthy features.

Mesabi range.—Two new mines reported production on the Mesabi range—the Wellington, at Chisholm, and the Rouchleau, at Virginia—and stripping was in progress at four or five others. Three new ore-concentration plants were completed on the Mesabi, two at Calumet and one at Gilbert, and one crushing plant was completed near Hibbing. It is reported that at the end of 1920 there were 21 active concentration plants in Minnesota, 19 of them on the Mesabi range and 2 on the Cuyuna.

The developments at Babbitt, on the east end of the Mesabi range, affecting the mining and concentration of the lean magnetite ore of that locality are perhaps the most notable of the year, and they are of interest not only in the Lake Superior district but to the iron-mining industry throughout the world; for if they are a commercial success they will undoubtedly stimulate interest in the treatment of siliceous iron ores including hematite and limonite as well as magnetite. The potential reserves of iron ore below the present commercial grade are so vast that no ore famine need be anticipated for many generations if processes for the recovery of their iron content are perfected. That such processes will be brought into use as fast as local conditions and prices warrant there seems no reason to doubt, but probably there will be incidental financial losses in some of the pioneer work, as is usual in such undertakings. In Minnesota the State School of Mines experiment station has for many years been doing commendable work on problems of iron-ore concentration with a view to paving the way for utilization of the lower grades of ore, and such assistance as the School of Mines has furnished has undoubtedly saved a great deal of money to the ore companies that have pioneered in the field of ore concentration and has insured a steadier transition in mining from higher to lower grades of ore. The cooperation between this experiment station and mining engineers of Duluth led to the building of an experimental mill in that city in which machines were given practical tests and perfected for the special purposes in view. The results were encouraging, and the year 1920 witnessed the beginning of construction at Babbitt of the first unit of what is hoped will develop into the largest metallurgic mill in the world. Owing to many handicaps, including a fire early in 1921, it is not expected that this first unit will be in operation before the beginning of shipping in 1922. According to Woodbridge,[7] about $1,500,000 was expended in construction up to the end of 1920, besides about $750,000 in land purchases, explorations, and experimental work. A temporary town has been built at Babbitt, and a permanent town will be developed in the vicinity if the enterprise proves successful. The iron-bearing material which is to be treated by this new plant consists of hard rock containing principally quartz, amphibole, and magnetite, with a number of other minerals characteristic of metamorphosed rocks in minor quantities, including garnet, fayalite, pyroxenes, and graphite. The richest beds contain from 20 to 30

[7] Woodbridge, D. E., Iron Age, Jan. 13, 1921, p. 127.

per cent of iron. The beds with as much as 30 per cent of iron in a concentrable form are relatively thin, but these, together with thick beds containing 20 per cent of iron, constitute an immense tonnage.[8] According to the Minnesota Geological Survey, the east Mesabi range from Birch Lake to Mesaba contains about 1,500,000,000 tons of the magnetite formation within 100 feet of the present rock surface, without any bedrock cover.

Recent experiments in very fine grinding of this ore are reported [9] to have produced a concentrate passing 300-mesh sieve which assayed 71.96 per cent iron. (Pure magnetite contains 72 per cent of iron.) This concentrate was sintered without difficulty by the use of soft coal. The process thus involves crushing to various sizes and finally very fine grinding of part of the rock and the separation of ferruginous from siliceous material chiefly by magnetic means, the coarser material being dry and the exceedingly fine material being treated in a wet magnetic separator designed by E. W. Davis, of the Minnesota School of Mines experiment station.

It is this wet magnetic separator that delivers the practically pure magnetite. The concentrates are finally sintered by fusing with cheap, fine fuel in the form of coke breeze, anthracite dust, or other fines. The quality of the resulting sinter is exceptionally high. Davis has outlined the process as follows:[10]

> The whole process of magnetic concentration as applied to the eastern Mesabi magnetites is a good illustration of the manner in which the various types of machines can be made to work together so as to produce a high-grade furnace product from an ore material containing only 25 per cent of iron in the form of magnetite. The hard rock is first crushed to about 3-inch size and is then passed over a magnetic cobber. The field strength of this cobber is so adjusted that all of the coarse material containing no magnetic iron is discarded as tailing. The concentrate from this cobber is still too low grade to be useful, and is, therefore, crushed again to 2-inch size. This material is passed over a second cobber and the worthless gangue again discarded. This process of crushing, cobbing, and discarding worthless material continues until the product has been reduced to about ¼-inch size. When this stage has been reached, approximately one-half the ore has been discarded as tailing and the other half contains practically all of the magnetic oxide that was originally present in the rock. This ¼-inch material, however, still contains too much gangue to be considered a desirable furnace product. It is, therefore, crushed wet in ball mills until it will pass a 100-mesh screen. This fine material is concentrated by magnetic log-washers in which the final separation is made. The concentrate produced by these machines is then dewatered by the use of continuous filters, in the tank of which the fuel for sintering is mixed. The filter cake is conveyed directly to the sintering plant, where the ore is agglomerated. After being sintered the ore is screened in order to remove any fine material, and only the clean, coarse sinter is shipped to the furnaces. It is apparent that in order to make this process a success financially a large initial investment is necessary. The plant must be built in the most substantial manner, and only that machinery can be used which will operate efficiently and continuously under heavy loads and with little personal attention. At best the profit per ton that can be made is small, and in order to make the proposition attractive financially a plant of large capacity is necessary. While this process is a success, from the metallurgical point of view, its financial worth must yet be demonstrated.
>
> The Mesabi Iron Co. is now undertaking the last stage in the experiment; that is, the proving of the financial worth of the process. A plant is being built on the eastern end of the Mesabi range, and it is hoped that within a year or two this plant will be in operation and will be contributing its share of ore to the yearly shipment from the district. It is extremely fortunate for the district and for the whole State that responsible individuals, who are willing to expend large sums of money in order to deter-

[8] Grout, F. F., and Broderick, T. M., The magnetite deposits of the eastern Mesabi range, Minn.: Minnesota Geol. Survey Bull. 17, pp. 12–14, 35–36, 1919.

[9] Woodbridge, D. E., op. cit., p. 127.

[10] Davis E. W., The future of the Lake Superior district as an iron-ore producer: Minnesota School of Mines Exper. Sta. Bull. 7, pp. 15–17, 1920.

mine whether or not it is economically possible to produce a merchantable ore from this low-grade rock, have become interested in this problem. Any half-hearted attempt at the solution of this problem would have resulted in failure and would have been discontinued long ago. This is the first serious endeavor to utilize the really low-grade ores of this district, and if the experiment is successful, a remarkable stimulus will be given the low-grade iron-ore industry of the Lake Superior region.

If the hard rock of the eastern Mesabi, containing only 20 to 30 per cent iron, can be mined, crushed, and concentrated into merchantable ore, it is not difficult to believe that the vast amount of comparatively soft hematite, containing from 35 to 45 per cent iron, can first be rendered magnetic by roasting and then concentrated magnetically in the same manner as described above for eastern Mesabi rock. It will be necessary for some group of men having ample financial resources to undertake the work of proving the possibilities of this method of treatment, exactly as the Mesabi Iron Co. is doing with the magnetic ores.

It is estimated that at least 2½ tons of rock must be mined and treated in order to yield 1 ton of shipping product, and therefore if the lean magnetite is to be mined and concentrated profitably in competition with the richer hematite of the Mesabi and other ranges there must be certain inherent advantages possessed by the magnetite deposits that will offset the greater cost of preparation of the ore for market. These deposits crop out for considerable distances or else are covered by only a few feet of unconsolidated overburden, and thus the large expense of stripping incidental to large open-pit mines farther west on the range is saved. The beds dip at a low angle, about 5°, and can thus be easily quarried at lower cost than if mined underground. The high iron and low phosphorus content of the concentrates, it is expected, will enable the ore to command a price about $1.50 a ton higher than old range Bessemer ore at lower Lake ports, and there should be a saving in freight costs per ton of pig iron on account of the superior grade of ore shipped. Incidentally it is expected that a by-product in the form of crushed hard rock of small, uniform size can be shipped in large quantities for use as road metal and railroad ballast. There is consequently much reason for hope that with large-quantity production a sufficient advantage will accrue to warrant commercial development of this interesting and important ore reserve.

Vermilion range.—Operations on the Vermilion range did not attract particular attention, the output of ore in 1920 having increased only slightly as compared with 1919. The increase in royalty rates is illustrated in the re-leasing of the Zenith mine at a royalty of about $1.60 a ton in 1920, said to be one of the highest rates paid in the Lake region. The ore in the Zenith mine is of high grade.

Cuyuna range.—On the Cuyuna range little exploration was under way in 1920, and many of the underground manganiferous mines that were active during the war were closed. Considerable manganiferous ore was shipped from stock piles, however, and several mines were active producers in response to an increased demand for this ore. One new mine, the Maroco, was opened, a shaft having been sunk, a washer built, and stripping begun. Operations continued at a normal rate at most of the producing mines on the "north range" between Riverton and Cuyuna, and several shafts were deepened. The Portsmouth mine was a new shipper. Several mining operations have been discontinued temporarily, because of the exhaustion of the ore that can be profitably mined under present conditions.

Gogebic range.—The Gogebic range shipped a record quantity of ore in 1920. Much ore is being developed at considerable depth, steel and concrete shafts have been built, and mines are equipped for electric operation throughout. Some exploration was done on the east end of the range, but developments consisted chiefly in mining known ore bodies.

Marquette range.—Production from the Marquette range increased 7 per cent in 1920, compared with 1919. An item of interest is the entry of the Ford Motor Co. into the iron-mining field. This company completed and put into operation in 1920 its own blast furnaces at River Rouge, Mich., and in order to control its ore supplies it has taken over properties of the Michigan Land & Iron Co., reopened the old Imperial mine, near Michigamme, and will explore for further ore bodies.

Menominee range.—Drilling near Escanaba indicated the presence of the iron-bearing formation, but no ore was discovered. This locality is about 25 miles east of Waucedah, the point farthest east at which ore has been mined on the Menominee range. Enlargement of power plants and electrification of mines were characteristic activities.

In the Iron River-Crystal Falls district of the Menominee range there was normal activity due to good demand for high-phosphorus ores, which are desirable in the manufacture of foundry iron. On account of car and labor shortages during the first part of the season not all the stock-piled ore was shipped. Shafts were sunk and electric equipment installed at many mines.

Iron-ore reserves.—Estimates of ore reserves for Minnesota, furnished by Rukard Hurd, director of mines of the Minnesota Tax Commission, and for Michigan, furnished by R. A. Smith, State geologist, including developed and prospective ore in the ground and ore in stock piles, show a decrease of 58,000,000 gross tons in Minnesota and an increase of 4,600,000 tons in Michigan. The reserves in all three producing ranges in Minnesota decreased; in Michigan all the producing ranges showed increases, owing to active prospecting.

Iron-ore reserves in Minnesota May 1, 1917, 1918, 1919, and 1920, in gross tons.

Range.	1917	1918	1919	1920
Mesabi	1,381,754,428	1,362,277,471	1,328,821,214	1,305,926,735
Vermilion	11,961,684	12,251,025	11,621,197	10,927,844
Cuyuna	70,159,848	63,208,588	59,393,443	24,819,959
	1,463,875,960	1,437,737,084	1,399,835,854	1,341,674,538

Iron-ore reserves in Michigan, Jan. 1, 1918, 1919, 1920, and 1921, in gross tons.

Range.	1918	1919	1920	1921
Gogebic	55,813,661	63,497,143	64,563,003	64,964,666
Marquette	78,175,301	64,254,626	70,114,034	72,984,624
Menominee (including Iron River and Crystal Falls districts)	66,154,547	75,819,940	63,929,438	65,311,868
	200,143,509	203,571,709	198,606,475	203,261,158

SOUTHEASTERN STATES.

The five southeastern States that produce iron ore on an important scale, Alabama, Georgia, North Carolina, Tennessee, and Virginia, enjoyed a revival of iron mining in 1920, the increases in production ranging from 5 per cent in Virginia to 47 per cent in Georgia. In the Cranberry district, N. C., concentration of magnetite was discontinued and the ore was shipped direct to the blast furnace at Johnson City, Tenn.

In the Birmingham district the greater part of the output is hematite, or red ore, but there is also much brown ore—in fact the largest output of brown ore produced in any single mining district in the United States comes from the region near Birmingham.

The red ore, which is obtained from underground mines, lies in extensive beds or lenses that crop out along Red Mountain for about 25 miles and dip southeast at varying angles, averaging nearly 30°. Below the valley southeast of Red Mountain the dip diminishes and locally is reversed in places, so that the ore bed lies in a basin generally 1,200 to 2,000 feet below the surface. Mining began with open pits along the outcrops of the ore beds and then passed into underground mining from drifts and slopes, until many of the slopes have now become almost too long for economical haulage. In the last six to eight years considerable drilling has been done in the basin east of Red Mountain in order to locate favorable sites for future mine shafts. The shaft-mining stage was practically reached in 1920, when the inclined shaft of the Gulf States Steel Co. in Shades Valley, at Shannon, reached the ore bed at a vertical depth of 1,900 feet, or a shaft length of 2,600 feet. This mine is about 14,000 feet southeast of the ore outcrop. A vertical shaft was nearing completion late in 1920 by the Woodward Iron Co. in Shades Valley, 8,000 feet from the ore outcrop, where the ore is reported to lie at a vertical depth of 1,400 feet. The workable ore reached by these shafts is 9 feet or more in thickness and carries 35.5 to 40 per cent of metallic iron, 14 to 17.5 per cent of calcium oxide, and 13 to 14 per cent of insoluble matter. This ore is regarded as "self-fluxing," and recent drilling has disclosed a larger quantity of this grade of ore that may be won by shaft mining than was considered available a dozen years ago. More or less drilling has also been done in the field southeast of Red Mountain and northeast of Gate City, where the ore is too siliceous to be self-fluxing; but results have not been encouraging so far as quality of ore is concerned.[11]

NORTHEASTERN STATES.

Adirondack district.—Labor conditions are reported to have been good in the vicinity of Mineville, N. Y., in the Adirondack district, where the semicontracting system employed by one large company is reported to have resulted in high labor efficiency.[12] Operations in this vicinity continued much as usual, with larger output, the increase over 1919 approximating 6 per cent. At Lyon Mountain much development work has been done, a new shaft and a new separator having been completed.

[11] Dyer, Y. A., Alabama iron mining: Eng. and Min. Jour., Jan. 22, 1921, p. 180.
[12] Charlton, D. E. A., Iron mining in the United States: Eng. and Min. Jour., Jan. 22, 1921, pp. 144–145.

New Jersey, Pennsylvania, and southeastern New York.[13]—In New Jersey, after considerable diamond-drill prospecting, unwatering old workings, and sampling of the ore shoots, development work was begun at the Beach Glen mine on May 1 by the North Jersey Steel Co. A concentration mill with a capacity of 75 tons of crude ore an hour was expected to go into operation on February 1, 1921.

In Pennsylvania magnetic iron ore was mined at Cornwall, Lebanon County, and at French Creek, Chester County. Operations at Cornwall were on a somewhat larger scale than during 1919. The greater part of this ore was shipped to the concentrator at Lebanon, the remainder being sent to the blast furnace at Robesonia, Pa. Enlargement of the concentrator capacity at Lebanon was begun. Operations at Cornwall are all in open cuts with steam shovels. Preparations for sinking an inclined shaft to increase output are under way. At the French Creek mines, an underground operation, development work continued during the year, but shipments were slowed down owing to the destruction of the sintering plant at Birdsboro by fire. This plant is reported to have been rebuilt on improved lines.

In New York at the Forest of Dean mine, near Fort Montgomery, considerable improvement was made in the local housing conditions. Considerable development work was done at the mines at Sterlington.

FOREIGN TRADE IN IRON ORE.

IMPORTS.

The iron ore imported into the United States in 1920 increased 167 per cent in quantity and 108 per cent in value, as compared with the imports in 1919. The average value was $3.90 a ton in 1920 and $5.01 in 1919. Cuba produced 70 per cent of the ore imported, French Africa 12 per cent, Spain 5 per cent, Sweden 5 per cent, Morocco nearly 3 per cent, and Canada nearly 3 per cent. The accompanying diagram (fig. 9) indicates the source and district of entry of the iron ore imported into the United States.

Iron ore imported into the United States, 1918–1920.

Country.	1918		1919		1920	
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.
Cuba	632,442	$2,376,399	321,753	$1,221,949	889,852	$3,488,682
Spain	38,385	458,234	63,737	592,096	69,915	241,640
French Africa					158,879	462,222
United Kingdom	82	524	180	4,380	315	6,703
Canada	115,354	611,072	12,383	64,785	34,084	164,158
Sweden			61,540	384,067	63,861	340,519
France	1,205	18,075	6,376	57,000		
Norway			6,426	35,000	1,828	8,228
Mexico			75	392	124	982
Brazil			10	20		
British West Africa			3,981	26,000		
Germany					1	14
Hungary					4,380	8,710
Panama					802	4,532
Colombia					11,649	46,596
China					2	18
Kwangtung					1	21
British India					2,812	25,133
Morocco					34,950	165,246
Philippine Islands					1	*a* 250
	787,468	3,464,304	476,461	2,385,689	1,273,456	4,963,654

a Correct as reported by collector of customs, San Francisco, Calif.

[13] Charlton, D. E. A., op. cit.

Iron ore imported into the United States, 1872–1920, in gross tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1872–1880	1,188,267	1913	2,594,770	1918	787,468
1881–1890	7,663,630	1914	1,350,588	1919	476,461
1891–1900	5,869,757	1915	1,341,281	1920	1,273,456
1901–1910	11,798,568	1916	1,325,736		
1911	1,811,732	1917	971,663		40,557,953
1912	2,104,576				

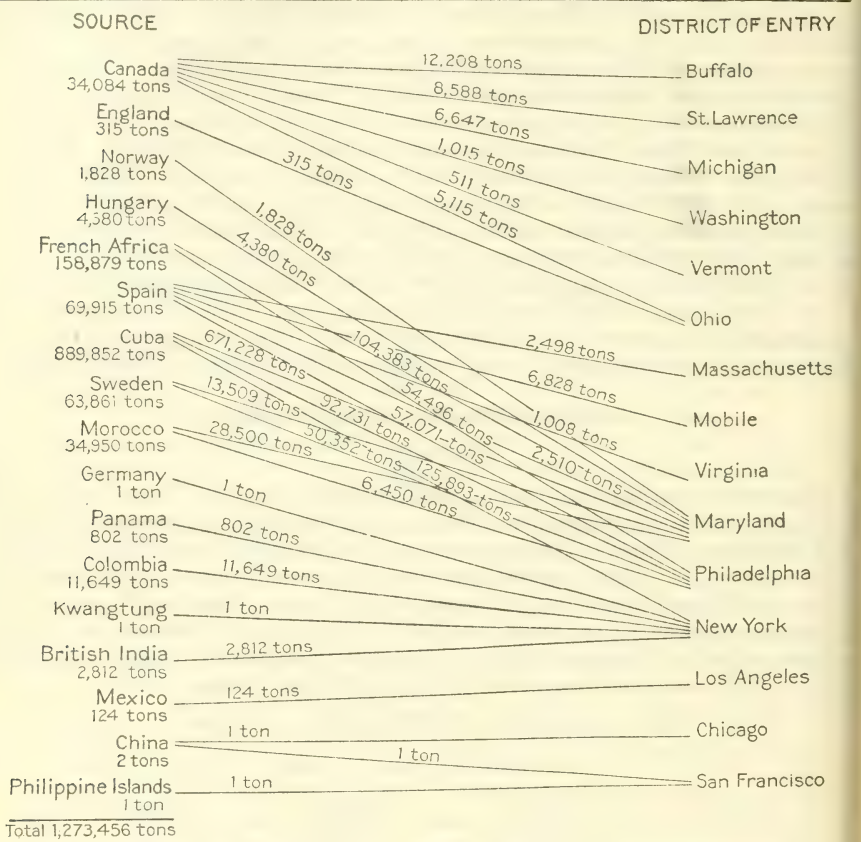


FIGURE 9.—Source and district of entry of iron ore imported into the United States in 1920.

EXPORTS.

The iron ore exported from the United States in 1920 was valued at $6,198,927, or $5.41 a ton, as compared with $4,308,746, or $4.32 a ton, in 1919. The exports represent an increase of 15 per cent in quantity and 44 per cent in value, as compared with 1919. With the exception of small quantities each to Mexico and Sweden, all the ore exported in 1920 went to Canada.

Iron ore exported from the United States, 1899–1920, in gross tons.

Year.	Quantity.	Year.	Quantity.
1899–1900	92,125	1916	1,183,952
1901–1910	2,713,397	1917	1,132,313
1911	768,386	1918	1,256,383
1912	1,195,742	1919	996,569
1913	1,042,151	1920	1,145,037
1914	551,618		
1915	707,641		12,785,314

IRON-ORE MINING IN CUBA.

The iron ore shipped from Cuba to the United States in 1920 was valued at $3,232,851, compared with $1,075,828 in 1919, and showed an increase in quantity of 147 per cent and in value of 200 per cent. The average price of the ore was $3.66 a ton in 1920, compared with $3.01 in 1919. The shipments in 1920 consisted of 64 per cent of hematite, including a little magnetite, from the Daiquiri and Juragua mines, on the southern coast, and of 36 per cent of brown ore from the Mayari mines, near the northern coast. In 1920 the iron content of the hematite, dried at 212° F., was reported at 57.26 per cent, and the brown ore carried 45.07 per cent (natural) and 55.06 per cent (nodulized); in 1919 hematite (natural) averaged 58.09 per cent, and the brown ore carried 48.10 per cent (natural) and 55.83 per cent (nodulized).

The total stock of ore (natural and nodulized) reported as on hand at the end of 1920 was 691,168 gross tons, compared with 1,232,187 tons at the end of 1919, a decrease of 44 per cent. This indicates that more than 60 per cent of the ore shipped in 1920 was taken from stock.

The following table shows the shipments of iron ore from Cuba since the opening of the mines in 1884. The curtailment of the production of iron ore in Cuba as a result of the World War is shown by these statistics. The shipments in 1920 were the largest since 1913. The statistics of the shipments of Cuban iron ore are collected by the United States Geological Survey.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1920, in gross tons.

Year.	Juragua mines (hematite and magnetite).	Sigua mines (hematite).	Daiquiri mines (hematite and a little magnetite).	Mayari mines (brown ore).	Guamá mines (hematite).	El Cuero mines (hematite).	Total.
1884–1890	1,142,519						1,142,519
1891–1900	[a] 2,348,473	20,438	[b] 979,992				3,348,903
1901–1910	2,104,186		[c] 4,456,440	307,700	41,241	224,729	7,134,296
1911	355,132		252,717	387,791		168,074	1,163,714
1912	360,094		463,533	446,176		127,994	1,397,797
1913	369,213		591,322	491,713		130,183	1,582,431
1914	267,641		284,507	228,949		40,013	821,110
1915	215,032		245,590	300,896		65,930	827,448
1916	212,013		181,602	258,451		60,650	712,716
1917	39,784		181,028	287,904		44,769	553,485
1918	17,128		353,103	232,540		40,761	643,532
1919			279,700	78,080			357,780
1920	(*d*)		[d] 561,268	321,515			882,783
	[d] 7,431,215	20,438	[d] 8,830,802	3,341,715	41,241	903,103	20,568,514

[a] Of this quantity, 5,932 tons was sent to Pictou, Nova Scotia.
[b] Of this quantity, 51,537 tons was sent to foreign ports.
[c] Of this quantity, 12,691 tons was sent to foreign ports.
[d] Shipments in 1920 of Juragua mines included with Daiquiri mines.

PRODUCTION OF IRON ORE IN PRINCIPAL COUNTRIES.

The following table of production of iron ore in the principal countries is far from complete, as it has not been possible to obtain certain figures, such as those for Russia, for 1916, and for later years figures for still other countries are not available.

Iron ore produced in some principal countries 1913 and 1916–1920, in metric tons.

Country	1913	1916	1917	1918	1919	1920	Source of data [a]
North America:							
Canada [b]	270,984	249,632	195,317	191,967	178,960	115,963	1913–1920, 1.
Cuba [b]	1,977,770	724,119	342,341	652,220	963,322	896,352	1913–1920, 2.
Newfoundland [b]	1,436,859	918,221	901,172	769,406	451,655	585,074	1913–1920, 1.
United States	62,972,124	76,379,355	78,493,473	70,772,816	61,643,913	68,649,317	1913–1920, 2.
South America:							
Chile	14,100	56,166	5,006	2,743			1913–1917, 3; 1918–1920, 2.
Venezuela [c]	58,141						1913, 4.
Europe:							
Austria-Hungary	5,318,531	[d]	3,744,456	[d]	[d]	[d]	1913, 5; 1917, 31.
Belgium	150,450	36,430	17,000	900	4,826	[d]	1913–1919, 6.
France	21,917,870	1,640,624	2,636,721	5,671,851	[e] 9,412,786	[e] 13,871,187	1913–1918, 7; 1919–1920, 9.
Germany	[e] 28,997,993	[e] 21,332,664	[e] 22,464,780	[e] 18,392,249	[d]	[d]	1913–1917, 10; 1918, 10 and 11.
Greece	314,572	84,995	63,364	67,671	46,639	44,751	1913–1917, 12; 1918–20, 1919–1920, 9.
Italy	973,116	942,244	993,825	993,872	613,025	823,300	1913–1916, 13; 1920, 9.
Luxemburg	7,324,492	6,997,854	4,372,692	3,131,499	3,411,602	[d]	1913–1917, 10; 1918, 11; 1919–20.
Norway	544,596	417,499	302,735	95,287	[d]	[d]	1913–1918, 14.
Portugal	49,182	2,261	7,384		8,712	12,845	1913, 5; 1915–1918–20; 1919–1920, 9.
Russia	9,513,945	[d]	[d]	[d]	[d]	[d]	1913, 15.
Spain	9,869,662	5,859,861	5,551,071	4,662,651	4,640,061	4,167,693	1913–1919, 16; 1920, 9.
Sweden	7,475,571	6,966,209	6,217,172	6,622,963	4,961,110	[d]	1913–1919, 17.
United Kingdom	16,254,095	13,711,237	15,084,098	14,847,571	12,450,975	12,911,449	1913–1920, 18.
Asia:							
China	[f] 429,000	278,555	304,356	[e] 382,716	[e] 845,430	[e] 842,932	1913, 19; 1915–1917, 5; 1918–1920, 9.
Chosen	142,012	245,255	140,813	202,382	425,267	[d]	1913–1916, 4; 1917, 20; 1918–1919, 20.
India	376,797	418,418	419,991	340,607	572,798	[d]	1913–1919, 21.
Japan	171,656	158,815	[d]	252,436	204,846	[d]	1913–1918, 4; 1918–1919, 22.
Africa:							
Algeria	1,342,899	1,042,865	985,293	962,465	735,879	1,071,278	1913–1918, 7; 1919–1920, 23.
Rhodesia		4,887	4,799	5,765	2,268		1916–1920, 24.
Tunis	887,000	500,935	676,052	421,543	[d]	[d]	1913–1918, 7.
Union of South Africa				4,526	3,252	2,526	1918–1920, 25.
Oceanica:							
Australia—							
New South Wales [g]	75,931	95,626	97,846	120,548	143,134	161,236	1913–1919, 26; 1920, 8.
Queensland	43,934	44,879	25,467	43,969	26,072	21,695	1913–1919, 27; 1920, 8.
Southern Australia	63,532	191,352	333,657	281,154	272,840	419,667	1913–1920, 28.
Philippine Islands	[d]	[d]	[d]	[d]	12,398	[d]	1919, 29.

a 1, Canada Dept. Mines, Mines Branch; 2, U. S. Geol. Survey; 3, Anuario estadístico de la República de Chile; 4, Bur. Foreign and Domestic Commerce; 5, National Federation of Iron and Steel Manufacturers (London); 6, Statistique des industries extractives et métallurgiques; 7, Statistique de l'industrie minérale; 8, official preliminary; 9, Min. Jour., Apr. 24, 1920; 10, Vierteljahrshefte zur Statistik; 11, Comité central des houillères de France, No. 532; 12, Tableaux statistiques du mouvement minier; 13, Revista del servizio minerario; 14, Norges officielle Statistikk; 15, Russian Consular Dept, Mining and Metallurgical Industries; 16, Estadística minera de España; 17, Bergsstaterna Sveriges officiella Statistik; 18, Mines and Quarries (London); 19, Iron Trade Review; 20, official data furnished by American consul general, Kobe (Seoul), Chosen, and American embassy, Tokyo, Japan; 21, Records Geol. Survey of India; 22, Mining Industry of Japan; 23, consular report; 24, Rept. Secretary for Mines; 25, Ann. Rept Dept. Mines and Industries; 26, Ann. Repts. Dept. Mines; 27, Ann. Repts. Under Secretary for Mines; 28, Review of mining operations, Dept. Mines; 29, Mineral resources of the Philippine Islands; 30, Imperial Mineral Resources Bureau, London. [b] Shipments. [c] Exports. [d] No data available. [e] Includes Lorraine. [f] From Tayeh deposit. [g] Includes iron ore from State mines received at Eskbank iron works, Lithgow, also ironstone for flux and iron oxide.

BENEFICIATED IRON ORE.

The processes reported as employed in 1920 to improve the quality of the ore at various mines were crushing and screening, drying by direct heat and by steam, hand picking on tables and on belts, washing by means of hydraulic jets and logs, jigging, electromagnetic cobbing, other concentration and separation, calcining, nodulizing, and desulphurization by sintering. Some of the operations combined two or more of these processes. Iron ores were reported as beneficiated at 98 mines in 13 States in 1920 and at 93 mines in 14 States in 1919. In addition to these processes some iron ore is recovered in the form of blast-furnace ore dust, but no statistics have been gathered on this subject. Ore so recovered has been originally accounted for in the statistics of shipments from the mines.

The total beneficiated ore reported as shipped from mines in the United States in 1920 increased 16 per cent in quantity and 38 per cent in value, as compared with 1919. From such figures as are available, showing the relation between crude ore treated and beneficiated ore recovered, it is apparent that in washing brown ore the ratios, by weight, of crude ore washed to resultant concentrates range from 5.99 : 1 to 1.25 : 1; in concentrating hematite the ratios range from 2.001 : 1 to 1.09 : 1; in magnetite they range from 3.187 : 1 to 1.042 : 1; and in carbonate they range from 1.519 : 1 to 1.25 : 1.

Beneficiated iron ore shipped from mines in the United States, 1919 and 1920.

State.	Variety.	1919		1920	
		Quantity (gross tons).	Value.	Quantity (gross tons).	Value.
Alabama	Hematite, brown ore	961,943	$2,921,467	1,273,772	$4,497,240
Georgia	Brown ore	42,385	255,345	81,013	487,333
Michigan	Hematite	158,648	677,175	231,511	1,021,875
Minnesota	do	4,714,347	17,347,283	5,992,468	25,172,816
New Jersey	Magnetite, brown ore	238,125	1,715,250	317,500	2,381,250
New York	Magnetite	444,198	1,721,449	495,402	1,896,729
North Carolina	Magnetite, brown ore	38,426	152,331	72,658	316,274
Pennsylvania	do	825,425	1,981,196	895,984	2,775,950
Tennessee	Hematite, brown ore	170,761	598,454	236,773	1,054,468
Virginia	do	102,463	470,235	98,254	478,844
Other States[a]	Hematite, brown ore, magnetite	25,209	124,402	9,772	58,632
		7,801,534	27,164,941	9,204,659	37,221,236

[a] 1919: Connecticut, Maryland, Massachusetts, New Mexico, and Texas. 1920: Connecticut, Maryland, Massachusetts, and Missouri.

IRON AND STEEL.

The records of the production and sales of iron and steel in 1920, in comparison with former years, are shown in the following pages. The data are derived in part from producers who report directly to the United States Geological Survey and in part from several other authoritative sources, such as the American Iron and Steel Institute, Metal Statistics, the Iron Age, the Iron Trade Review, and the Bureau of Foreign and Domestic Commerce of the Department of Commerce.

PIG IRON.

SHIPMENTS, VALUE, AND PRODUCTION, BY STATES.

According to reports to the United States Geological Survey by the manufacturers, the shipments of pig iron, exclusive of ferroalloys, in 1920 increased 19 per cent in quantity and 47 per cent in gross value as compared with 1919. The values stated represent the approximate amounts received for the iron f. o. b. furnaces and eliminate freight costs, selling commissions, and other items which are included in some of the market prices of pig iron as published in the trade journals.

The pig iron shipped includes the metal produced from foreign as well as from domestic ore. The pig iron derived from ore imported from Algeria, Canada, Cuba, Spain, and Sweden, although it constitutes a very small percentage of the total production, amounted in 1920 to 599,537 gross tons, valued at $24,668,410, as compared with 273,551 tons, valued at $8,105,532, in 1919. In the manufacture in 1920 of 606,284 gross tons of pig iron, 1,052,149 gross tons of foreign iron ore, including 83,836 tons of cinder derived from foreign pyrite, was reported to have been used, thus indicating an average pig-iron yield of 57.62 per cent from imported ore. Domestic ore, including 5,566,292 gross tons of cinder, scale, and scrap, and amounting to 70,238,186 gross tons, was reported in 1920 as used in the manufacture of 35,636,464 tons of pig iron, thus indicating a yield of 50.74 per cent in pig iron from domestic materials. The total production in 1920 of pig iron, exclusive of ferroalloys, reported to the Geological Survey was 36,242,748 gross tons.

In the second following table are given the shipments and their value at the furnaces of pig iron by the principal grades in 1919 and 1920.

Pig iron shipped from blast furnaces in the United States, 1919 and 1920, by States.

State.	1919		1920					
					Increase or decrease.		Percentage of increase or decrease.	
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity.	Value.
Alabama	2,044,937	$53,092,133	2,339,939	$76,520,797	+ 295,002	+$23,428,664	+14	+ 44
Illinois	2,532,341	61,829,286	3,238,814	90,736,015	+ 706,473	+ 28,906,729	+28	+ 47
Indiana	2,287,068	51,474,116	2,418,048	61,852,856	+ 130,980	+ 10,378,740	+ 6	+ 20
Kentucky	149,951	4,508,129	230,316	7,306,711	+ 80,365	+ 2,798,582	+54	+ 62
Michigan	416,277	13,418,185	464,197	16,812,062	+ 47,920	+ 3,393,877	+12	+ 25
Missouri	49,383	1,649,271	81,682	3,678,623	+ 32,299	+ 2,029,352	+65	+123
New Jersey	111,362	3,505,635	88,408	3,380,145	− 22,954	− 125,490	−21	− 4
New York	1,854,594	49,784,659	2,415,627	89,416,703	+ 561,033	+ 39,632,044	+30	+ 80
Ohio	6,994,999	178,999,271	8,229,770	246,326,276	+1,234,771	+ 67,327,005	+18	+ 38
Pennsylvania	11,901,992	307,824,587	13,472,814	448,251,415	+1,570,822	+140,426,828	+13	+ 46
Tennessee	155,663	5,152,860	217,887	9,271,324	+ 62,224	+ 4,118,464	+40	+ 80
Virginia	288,458	9,094,135	390,372	16,086,946	+ 101,914	+ 6,992,811	+35	+ 77
West Virginia	250,310	6,267,067	489,689	15,927,822	+ 239,379	+ 9,660,755	+96	+154
Wisconsin	282,830	8,320,521	363,588	12,355,028	+ 80,758	+ 4,034,507	+29	+ 48
Other States [a]	810,066	20,995,188	1,269,076	42,981,373	+ 459,010	+ 21,986,185	+57	+105
	30,130,231	775,915,043	35,710,227	1,140,904,096	+5,579,996	+364,989,053	+19	+ 47

[a] 1919: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, Texas, and Washington; 1920: Colorado, Connecticut, Maryland, Massachusetts, and Minnesota.

Pig iron shipped from blast furnaces in the United States in 1919 and 1920, by grades.

Grade.	1919			1920		
	Quantity (gross tons).	Value.	Average price a ton.	Quantity (gross tons).	Value.	Average price a ton.
Charcoal	273,161	$9,919,171	$36.31	301,185	$12,730,135	$42.27
Foundry	4,470,429	132,024,290	29.53	5,195,470	193,186,411	37.18
Basic	14,512,958	348,886,821	24.04	16,639,716	499,089,466	29.99
Bessemer	9,267,342	233,860,019	25.23	11,627,398	362,816,613	31.20
Low phosphorus	284,891	12,383,465	43.47	368,268	16,279,819	44.21
Malleable	969,406	29,258,377	30.18	1,210,853	42,973,332	35.49
Forge	282,799	7,741,897	27.38	304,197	11,327,920	37.24
All other (not ferroalloys)	69,245	1,841,003	26.59	63,140	2,500,400	39.60
	30,130,231	775,915,043	25.75	35,710,227	1,140,904,096	31.95

The Bureau of Statistics of the American Iron and Steel Institute reports that the production in 1920 of all kinds of pig iron, including ferroalloys, produced in blast furnaces as well as some that was electrically produced, increased 5,910,623 tons, or 19 per cent, as compared with 1919.

Pig iron, including ferroalloys, manufactured in the United States in 1919 and 1920, in gross tons.[a]

State.	1919	1920	State.	1919	1920
Pennsylvania	12,276,585	13,983,134	Missouri		
Ohio	7,102,627	8,533,470	Iowa		
Illinois	2,558,213	3,280,875	Colorado		
Alabama	2,130,092	2,392,962	Montana	375,587	464,584
Indiana	2,715,659	2,939,521	Washington		
Michigan			Oregon		
New York	2,070,288	2,601,134	California		
New Jersey			Maryland	244,002	523,733
Wisconsin	605,619	711,405	Tennessee	190,514	283,207
Minnesota			Connecticut	13,678	10,281
West Virginia	413,091	772,379	Massachusetts		
Kentucky			Maine		
Texas					
Virginia	319,409	429,302		31,015,364	36,925,987

[a] Bureau of Statistics, American Iron and Steel Institute.

AVERAGE PRICES.

AT BLAST FURNACES.

The average price per gross ton at blast furnaces of all kinds of pig iron, by States, from 1915 to 1920, given in the following table is based on reports of the manufacturers to the Survey. These figures represent the approximate prices f. o. b. at the blast furnaces and do not include the prices of ferroalloys. The general average price for all grades of pig iron at the furnaces, exclusive of ferroalloys, showed an increase of 24 per cent for 1920.

Average price per gross ton of pig iron in the United States, 1915–1920.

State.	1915	1916	1917	1918	1919	1920
Alabama	$10.24	$14.59	$21.64	$30.58	$25.96	$32.70
Illinois	13.93	17.57	26.34	30.91	24.42	28.02
Indiana	(a)	(a)	(a)	29.09	22.51	25.58
Kentucky	13.44	17.97	28.78	34.19	30.06	31.72
Michigan	13.63	17.51	29.93	35.44	32.23	36.22
Missouri	(a)	(a)	(a)	36.97	33.40	45.04
New Jersey	(a)	(a)	35.25	34.22	31.48	38.23
New York	14.02	17.70	22.98	28.27	26.84	37.02
Ohio	12.96	15.75	27.30	30.31	25.59	29.93
Pennsylvania	13.69	17.95	29.87	31.69	25.86	33.27
Tennessee	12.09	15.13	26.26	34.08	33.10	42.55
Virginia	12.83	16.06	27.93	34.00	31.53	41.21
West Virginia	(a)	(a)	(a)	(a)	25.04	32.53
Wisconsin	13.20	17.77	27.39	38.08	29.42	33.98
Other States [b]	12.96	16.03	24.25	28.52	25.92	33.87
Average for United States	13.21	16.96	27.29	30.89	25.75	31.95

[a] Included in "Other States."

[b] 1915: Colorado, Connecticut, Indiana, Maryland, Massachusetts, Minnesota, Missouri, New Jersey, and West Virginia; 1916: California, Colorado, Connecticut, Indiana, Maryland, Massachusetts, Minnesota, Missouri, New Jersey, and West Virginia; 1917: Colorado, Connecticut, Georgia, Indiana, Maryland, Massachusetts, Minnesota, Missouri, Washington, and West Virginia; 1918: Colorado, Connecticut, Georgia, Maryland, Massachusetts, Minnesota, Washington, and West Virginia; 1919: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, Texas, and Washington; 1920: Colorado, Connecticut, Maryland, Massachusetts, and Minnesota.

Average price per gross ton of pig iron in the United States, 1889–1920.

1889	$15.78	1900	$18.85	1911	$14.07
1890	16.43	1901	15.25	1912	13.93
1891	15.50	1902	20.92	1913	15.08
1892	14.32	1903	19.12	1914	13.42
1893	11.90	1904	14.13	1915	13.21
1894	9.76	1905	16.63	1916	16.96
1895	11.14	1906	19.98	1917	27.29
1896	10.47	1907	20.56	1918	30.89
1897	9.85	1908	15.96	1919	25.75
1898	9.90	1909	16.25	1920	31.95
1899	18.00	1910	15.45		

COMMERCIAL QUOTATIONS.

The average monthly prices of the principal grades of pig iron either at the blast furnaces or at the nearest market in 1919 and 1920, according to published market quotations, are summarized in the following table for comparison with figures reported by blast-furnace operators as shown in preceding tables, and the commercial quotations during the last few years, which include the war period, are shown graphically in figure 10. The contrasts are marked between the moderate prices up to the end of 1916; the unregulated, extremely high prices at the middle of 1917; the even prices as regulated by the Government from October, 1917, to the end of 1918; the natural downward trend until October, 1919; the rapidly mounting price during the next year; and finally the rapid decline which brought the price at the end of 1920 down to about the level established by the War Industries Board in 1918.

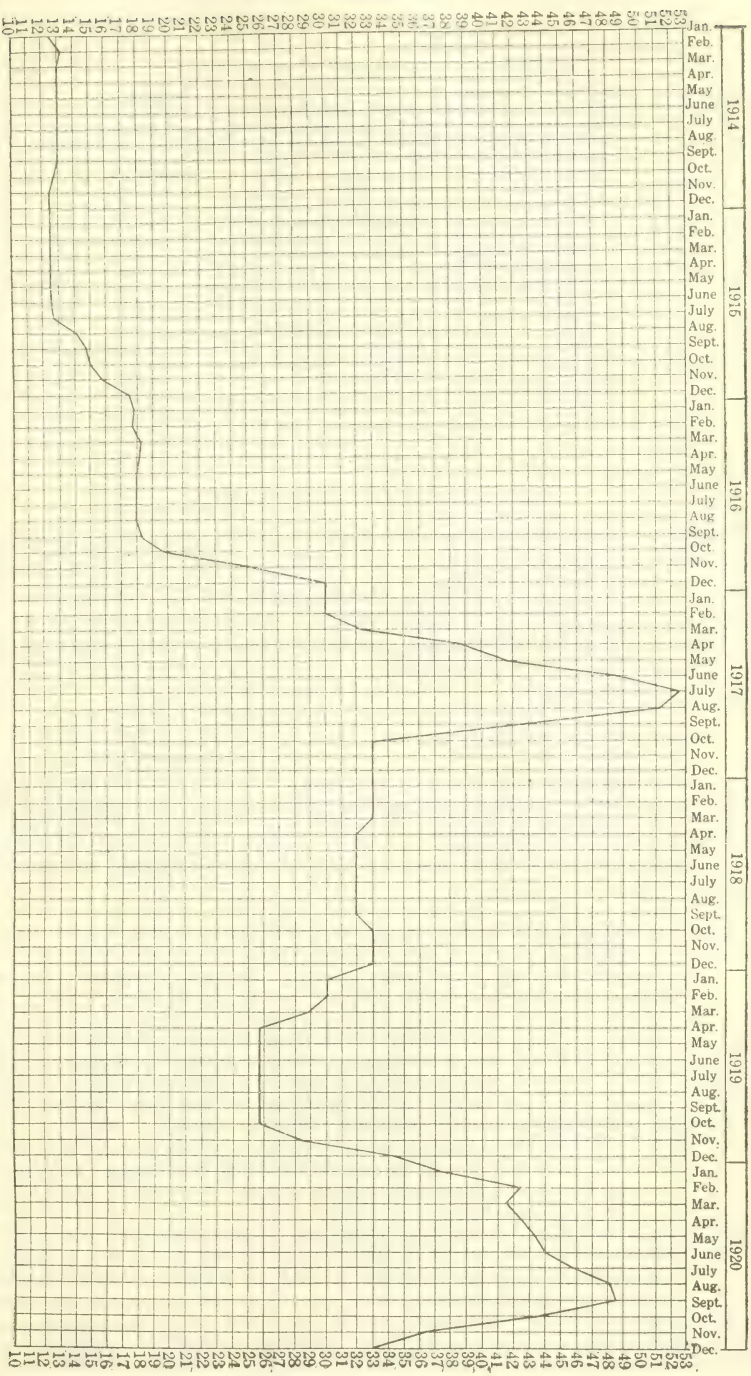

Dollars per gross ton
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1914
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1915
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1916
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1917
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1918
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1919
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1920

FIGURE 10.—Curve showing price of basic pig iron at blast furnaces in Mahoning and Shenango valleys, Ohio and western Pennsylvania, 1914-1920, by months.

Average monthly prices per ton of principal grades of pig iron, 1919 and 1920.[a]

Month.	1919				1920			
	Foundry pig iron at Valley furnaces.	Foundry pig iron at Birmingham, Ala., furnaces	Bessemer pig iron at Valley furnaces.	Basic pig iron at Valley furnaces.	Foundry pig iron at Valley furnaces.	Foundry pig iron at Birmingham, Ala., furnaces	Bessemer pig iron at Valley furnaces.	Basic pig iron at Valley furnaces.
January	$31.00	$31.00	$32.20	$30.00	$38.46	$37.77	$37.65	$36.62
February	31.00	31.00	32.20	30.00	41.00	40.00	41.67	42.13
March	27.88	28.44	30.73	28.53	42.00	40.00	42.00	41.50
April	26.75	26.75	27.95	25.75	42.42	40.00	42.21	42.13
May	26.75	25.28	27.95	25.75	43.96	42.00	42.54	43.12
June	26.75	24.14	27.95	25.09	45.00	42.00	43.23	43.62
July	26.75	26.01	27.95	25.75	45.15	42.00	45.58	45.42
August	26.75	27.18	27.95	25.75	47.85	42.00	47.35	46.96
September	26.75	27.50	27.95	25.75	50.00	42.00	48.50	48.50
October	26.90	27.78	27.95	25.75	46.62	42.00	47.67	44.00
November	30.76	30.21	29.44	27.83	40.72	39.02	40.84	37.62
December	35.46	34.81	35.27	33.88	35.77	36.42	35.00	33.00
Average	28.63	28.34	29.62	27.49	43.25	40.43	42.85	42.05

[a] Metal Statistics, 1921.

DAILY AVERAGE PRODUCTION.

The daily average production of coke and anthracite pig iron by months during the last six years is graphically illustrated in figure 11. There have been notable fluctuations during these years, but at no time since the beginning of 1915 has the rate fallen as low as at that time, and taken as a whole the curve indicates a large bulk production—possibly greater than will be shown by another similar series of years in the near future.

PRODUCTION BY GRADES AND ACCORDING TO FUEL USED.

The statistics of production of pig iron by grades and according to fuel used for 1916–1920 have been published by the American Iron and Steel Institute as follows. These figures include ferroalloys. Metals made with electricity and with coke and electricity are included in coke pig iron.

Pig iron manufactured in the United States, 1916–1920, by grades, in gross tons.

Grade.	1916	1917	1918	1919	1920
Bessemer and low phosphorus	14,422,457	13,714,732	13,024,966	9,975,934	12,062,084
Basic	17,684,087	17,671,662	18,646,174	14,494,131	16,737,722
Forge	348,344	345,707	393,932	271,286	318,048
Foundry and ferrosilicon	5,553,644	5,328,258	5,145,260	4,916,758	5,957,782
Malleable	921,486	1,015,579	1,117,914	1,009,049	1,310,951
Spiegeleisen	194,002	192,985	283,853	84,246	111,449
Ferromanganese	221,532	260,125	333,027	185,357	295,447
White, mottled, direct castings, etc	89,245	92,168	109,518	78,603	132,504
	39,434,797	38,621,216	39,054,644	31,015,364	36,925,987

Pig iron manufactured in the United States, 1916–1920, by fuel used, in gross tons.

Fuel used.	1916	1917	1918	1919	1920
Bituminous, chiefly coke	38,844,598	37,863,643	38,422,175	30,549,930	36,300,024
Anthracite and coke	217,788	381,048	283,592	138,337	302,567
Charcoal	372,411	376,525	348,877	327,097	323,396
	39,434,797	38,621,216	39,054,644	31,015,364	36,925,987

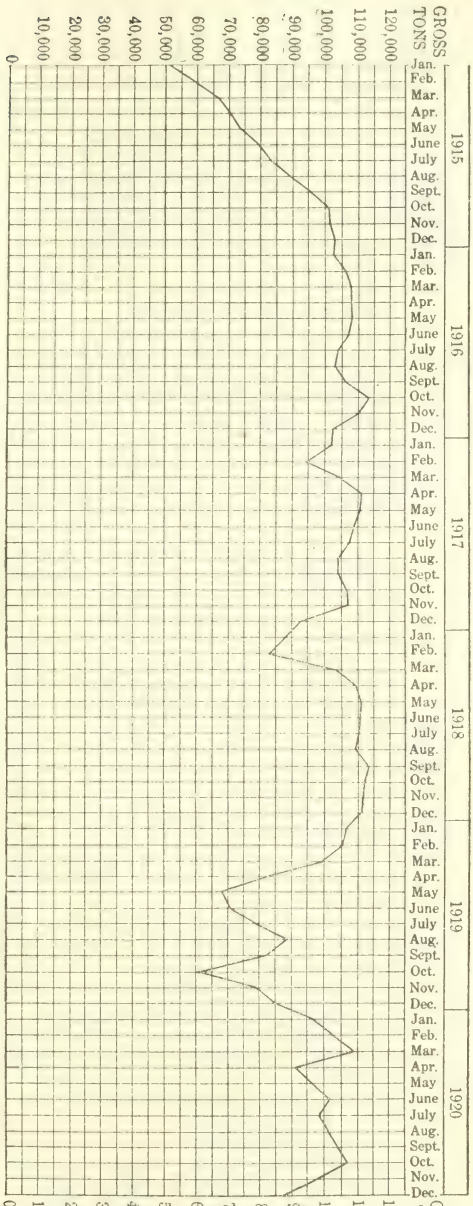


FIGURE 11.—Curve showing daily average production of coke and anthracite pig iron in the United States, by months, 1915–1920.

TOTAL DOMESTIC PRODUCTION OF PIG IRON.

The next table shows the production in the United States of pig iron, including the commoner ferroalloys, as far as has been recorded.

Pig iron manufactured in the United States, 1810–1920, in gross tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1810–1860	10,542,548	1911	23,649,547	1917	38,621,216
1861–1870	11,366,963	1912	29,726,937	1918	39,054,644
1871–1880	24,055,278	1913	30,966,152	1919	31,015,364
1881–1890	56,902,041	1914	23,332,244	1920	36,925,987
1891–1900	98,124,754	1915	29,916,213		
1901–1910	211,321,934	1916	39,434,797		734,956,619

BLAST FURNACES.

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for the years 1919 and 1920, not including any electric reduction furnaces, as published by the bureau of statistics of the American Iron and Steel Institute, are as follows:

Blast furnaces in the United States, 1919 and 1920.

State.	In blast June 30, 1919.	Dec. 31, 1919.			In blast June 30, 1920.	Dec. 31, 1920.		
		In.	Out.	Total.		In.	Out.	Total.
Pennsylvania	75	112	53	165	117	73	90	163
Ohio	48	54	25	79	65	49	30	79
Illinois	12	19	6	25	19	16	9	25
Alabama	17	22	22	44	28	15	28	43
New York	15	16	11	27	21	16	11	27
Virginia	3	6	12	18	10	4	13	17
Tennessee	2	7	9	16	10	3	14	17
Colorado	3	.....	6	6	3	3	2	5
Missouri	2	2	1	3	3	3	.....	3
Oregon	.....	.....	1	1	.....	.....	1	1
Maryland	1	4	1	5	4	2	5	7
New Jersey	2	1	3	4	2	1	3	4
Wisconsin	2	4	4	8	4	3	5	8
Minnesota	2	3	.....	3	2	2	1	3
Indiana	11	13	3	16	12	12	4	16
Michigan	12	10	2	12	11	10	3	13
West Virginia	1	2	3	5	4	3	2	5
Kentucky	1	4	3	7	5	.....	7	7
Georgia	.....	.....	4	4	.....	.....	4	4
Texas	.....	.....	1	1	.....	.....	1	1
Mississippi	.....	.....	1	1	.....	.....	1	1
Connecticut	.....	.....	2	2	1	.....	2	2
Massachusetts	.....	1	.....	1	1	1	.....	1
	209	280	173	453	322	216	236	452

FOREIGN TRADE IN PIG IRON.

IMPORTS.

The quantity of pig iron and ferroalloys, principally ferromanganese and ferrosilicon, imported into the United States in 1920 increased 83 per cent, compared with 1919. Separate statistics of imports of ferroalloys, given on page 394, indicate that the imports of pig iron alone (by difference) were 107,547 gross tons in 1920, compared with 58,171 tons in 1919. Canada and England furnished the largest quantity of these products in both years.

Pig iron, including kentledge, ferromanganese, ferrosilicon, and spiegeleisen, imported into the United States, 1916–1920, in gross tons.

Country.	1916	1917	1918	1919	1920
North America:					
Canada	33,716	21,143	5,692	63,091	101,071
Mexico			120	5,994	
West Indies		83		30	
Europe:					
France					5
Germany	341				
Italy		20			
Sweden	792			51	105
United Kingdom: England	89,764	51,384	28,392	32,452	64,008
United Kingdom: Scotland		250		39	10,208
Asia:					
British India	1,313		501		1,977
China	8,861	3,503		8	3,555
Japan	562	85	6		3,851
Kwangtung					200
Other countries		318			964
	135,349	76,786	34,711	101,665	185,944

EXPORTS.

The pig iron exported from the United States in 1920 decreased nearly 33 per cent in quantity and 18 per cent in value, as compared with 1919. The largest quantities were shipped to Canada, Italy, Belgium, Netherlands, and Japan.

Pig iron exported from the United States to foreign countries, 1916–1920, in gross tons.

Country.	1916	1917	1918	1919	1920
North America:					
Canada	101,277	153,745	122,325	33,751	56,100
Costa Rica	68	26			50
Cuba	5,338	4,243	892	1,331	1,268
Mexico	676	920	297	1,103	2,348
Panama	1,968	1,816	881	483	624
South America:					
Argentina	380	2,580	129	4,137	2,121
Brazil	1,176	1,483	72	979	951
Chile	6,500	8,888	4,345	6,611	2,545
Peru	682	578	694	1,253	280
Europe:					
Austria-Hungary				417	
Belgium				8,625	28,680
Denmark	17,380	1,836		5,776	2,238
France	71,226	65,618	8,181	683	451
Germany					14,074
Italy	234,213	184,763	41,641	136,997	36,128
Netherlands	22,464	2,124		5,220	20,384
Norway	11,267	12,986	1,000	2,995	1,510
Russia	926	6,017			
Spain	8,464	5,891			
Sweden	20,707	17,799		2,844	8,207
Switzerland	3,671	1,404			2,649
United Kingdom:					
England	88,315	138,196	66,197	34,741	11,127
Scotland	2,249	7,874	7,591	11,268	5,868
Ireland	357	1,610	313		
Asia:					
Japan	5,033	30,809	11,986	49,734	13,448
Oceania:					
Australia	433	257	30	259	485
New Zealand	260	760		716	270
All other countries	2,206	3,997	3,001	11,338	5,022
	607,236	656,220	269,575	321,261	216,828
Value	$15,381,431	$24,037,051	$11,576,721	$12,313,183	$10,074,377

PRODUCTION IN PRINCIPAL COUNTRIES.

Pig iron produced in some principal countries, 1913, 1916–1920, in metric tons.

Country.	1913	1916	1917	1918	1919	1920	Source of data.[a]
Australia	47,308	128,616	148,762	210,266	237,446	(b)	1913–1917, 1; 1918–1919, 2 and 3.
Austria-Hungary	2,380,864	2,418,322	(b)	(b)	(c)	(c)	1913–1916, 1.
Austria	(d)	(d)	(b)	(b)	60,000	120,000	1919–1920, 4.
Belgium	2,484,690	127,825	7,990	.....	250,570	1,116,220	1913–1919, 5; 1920, 6.
Canada	1,024,176	1,060,727	1,061,836	1,084,580	832,593	989,115	1913–1919, 8; 1920, 6.
China	(b)	148,400	144,815	(b)	(b)	(b)	1916–1917, 1.
France	5,207,197	1,310,756	1,408,283	1,292,958	e 2,447,295	e 3,433,791	1913–1918, 9; 1919, 6; 1920, 10.
Germany	c 19,309,172	e 13,284,738	e 13,142,247	f 11,758,967	(b)	(b)	1913–1918, 1.
India g	(b)	279,734	254,407	285,817	360,037	(b)	1916–1919, 7.
Italy	426,755	467,005	471,188	313,576	239,710	(b)	1913–1919, 11.
Japan	h 240,288	h 385,647	122,782	180,930	209,005	377,616	1913–1916, 12; 1917–1918, 13; 1919, 14; 1920, 6.
Philippine Islands	227	93	66	70	67	87	1913–1920, 15.
Russia	4,868,140	4,350,000	3,215,000	(b)	(b)	(b)	1913, 16; 1916–1917, 18.
Spain	424,774	501,667	357,699	386,550	294,167	251,412	1913–1919, 17; 1920, 6.
Sweden i	736,330	743,031	838,948	767,922	494,033	(b)	1913–1919, 18.
United Kingdom	10,424,993	9,062,181	9,487,514	9,253,558	7,536,750	(b)	1913–1919, 19.
United States	31,461,610	40,065,754	39,239,155	39,679,518	31,513,161	37,518,649	1913–1920, 20.

a 1, National Federation of Iron and Steel Manufacturers (London); 2, Eskbank iron works production, Ann. Rept. Dept. Mines, New South Wales, 1918 and 1919; 3, Broken Hill proprietary production, Official Yearbook, Australia, Nos. 12 and 13; 4, Commerce Repts., Apr. 27, 1921: 5, Statistique des industries extractives et métallurgiques; 6, official preliminary; 7, Records Geol. Survey India; 8, Canada Dept. Mines, Mines Branch; 9, Statistique de l'industrie minérale; 10, consular report; 11, Rivista del servizio minerario; 12, Bur. Foreign and Domestic Commerce; 13, Financial and Economic Annual; 14, Mining industry of Japan; 15, Mineral resources of the Philippines; 16, General review of the principal branches of the mining and metallurgical industries (Russia); 17, Estadística minera de España; 18, Bergshantering Sveriges officiella Statistik; 19, Mines and Quarries (London); 20, American Iron and Steel Institute.

b Data not available.

c See under Austria.

d Included under Austria-Hungary.

e Includes Lorraine.

f Excludes Lorraine, Saar district, and Luxemburg for November and December.

g Includes cast-iron castings.

h Financial and Economic Annual of Japan reports 1913, 56,675 tons; 1916, 86,006 tons.

i Includes small tonnage of sponge iron.

FERROALLOYS.

SHIPMENTS, VALUE, AND PRICE.

The statistics of output of ferroalloys in the United States were separated from those of pig iron in these reports in order to arrive at more nearly accurate values for these commodities. Although the quantity of ferroalloys is small compared with the total shipments of pig iron, the price per ton is so much greater as to unduly increase the apparent average price of the pig iron if included with it.

The shipments of ferroalloys of all classes in 1920, according to producers' reports and to estimates by the United States Geological Survey, increased 46 per cent in quantity and 44 per cent in value, as compared with 1919. The ferrovanadium, ferromolybdenum, ferromanganese, spiegeleisen, ferrotungsten, ferrochromium, and ferrotitanium were made in part or wholly from ore imported from Africa, Bolivia, Brazil, British Columbia, Chile, China, Costa Rica, Cuba, Guatemala, India, Japan, Mexico, New Caledonia, Peru, Porto Rico, Portugal, Russia, and Turkey.

The following table was compiled from producers' reports and from estimates by the Geological Survey:

Ferroalloys of domestic manufacture shipped, 1919 and 1920.

Variety of alloy.	1919		1920		
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Average price a ton.
Ferromanganese	198,255	$27,093,816	276,594	$41,840,690	$151.27
Spiegeleisen	90,855	3,965,754	103,672	5,289,049	51.02
Ferrosilicon (7 per cent or more silicon)	103,244	5,973,398	193,580	11,634,650	60.10
Ferrophosphorus	6,706	714,339	18,935	2,129,657	112.47
Ferrotitanium	(a)	(a)			
Ferrochromium	15,763	5,106,442	16,606	5,708,277	343.75
Ferrovanadium	1,485	5,487,138	2,290	9,074,648	3,962.73
Ferromolybdenum	(a)	(a)	21	47,873	2,279.67
Ferrotungsten (65 per cent or more tungsten)	1,298	3,852,740	1,084	1,623,710	1,497.89
Other varieties [b]	2,032	1,537,337	26	170,813	6,569.73
	[c] 419,638	[c] 53,730,964	612,808	77,519,367	126.50

[a] Included with "Other varieties."
[b] 1919: Ferromolybdenum, ferrotitanium, and ferrozirconium; 1920: Ferrocerium, ferrotantalum-columbium, ferrouranium, and ferrozirconium.
[c] Revised figures.

In 1920 ferromanganese was made at 20 localities in the United States, spiegeleisen at 10, ferrosilicon at 23, ferrophosphorus at 2, ferrochromium at 9, ferromolybdenum at 4, ferrotitanium at 2, ferrotungsten at 8, ferrotantalum-columbium at 1, ferrocerium at 1, ferrouranium at 1, and ferrovanadium at 9. In many localities, of course, several alloys were made at the same plant. In all there were reported 51 localities at which ferroalloys were made in 1920, compared with 50 in 1919.

The following records of average contract prices of ferromanganese and of spiegeleisen by months for the last four years show a wide range. The ferromanganese prices are prices at eastern seaboard, except those for January to August, inclusive, and November, 1920, which are prices for material delivered; those of spiegeleisen are prices at furnaces.

Quoted prices per ton of ferromanganese and spiegeleisen, 1917–1920.[a]

Month.	Ferromanganese.				Spiegeleisen.			
	1917	1918	1919	1920	1917	1918	1919	1920
January	$175.00	$250.00	[b] $212.50	[c] $146.00	$57.50	$59.00	[d] $67.50	$46.60
February	192.50	250.00	165.00	[c] 160.00	66.25	59.00	[d] 52.50	57.60
March	212.50	250.00	134.00	[c] 172.00	77.50	65.50	[d] 42.50	60.40
April	250.00	250.00	113.75	[c] 200.00	76.75	[d] 70.00	[d] 34.50	66.85
May	375.00	[b] 250.00	110.00	[c] 200.00	78.00	[d] 71.00	[d] 31.35	75.00
June	400.00	[b] 250.00	111.75	[c] 198.00	83.00	[d] 75.00	[d] 27.50	75.00
July	400.00	[b] 250.00	111.00	[c] 190.00	85.00	[d] 75.00	34.00	75.00
August	387.50	[b] 250.00	110.00	[c] 193.75	81.25	[d] 75.00	34.00	79.35
September	380.00	[b] 250.00	165.00	167.00	80.50	[d] 75.00	34.00	82.00
October	300.00	[b] 250.00	110.00	151.00	73.50	[d] 75.00	34.00	80.00
November	247.50	[b] 250.00	110.00	[c] 153.00	63.25	[d] 75.00	34.00	74.35
December	247.50	[b] 236.00	121.00	145.00	60.00	[d] 72.50	39.00	64.40

[a] Iron Trade Review.
[b] Prices from May, 1918, to January, 1919, inclusive, based on 70 per cent ferromanganese; all other prices based on 80 per cent.
[c] Prices delivered; other ferromanganese prices at seaboard.
[d] Prices from April, 1918, to June, 1919, inclusive, based on 16 per cent spiegeleisen; all other prices based on 20 per cent.

IMPORTS.

The imports of ferromanganese were valued at $131.22 a ton in 1920, as compared with $129.72 a ton in 1919. The imports of spiegeleisen were valued at $53.10 a ton in 1920, as compared with $37.70 a ton in 1919. The imports of the alloys of the rarer metals are not all reported separately. For instance, the imports of ferrochromium, ferromolybdenum, and ferrotungsten are included with those of their respective metals.

Ferroalloys imported for consumption in the United States, 1918–1920.

Variety of alloy.	1918		1919		1920	
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.
Chrome or chromium and ferrochromium			414	$100,404	1,751	$428,619
Ferrophosphorus	10	$1,055	176	13,388	6	780
Ferrosilicon	5,540	424,932	10,445	629,362	13,909	719,446
Molybdenum and ferromolybdenum	32	19,280	46	40,759		
Titanium and ferrotitanium	(a)	10	5	3,317	1	713
Tungsten and ferrotungsten		8	177	287,981	892	1,180,829
Ferromanganese	27,168	4,258,745	33,022	4,283,541	59,254	7,775,278
Ferrovanadium			5	24,923	4	14,331
Spiegeleisen	1,969	228,012	27	1,018	5,234	277,900
	34,719	4,932,042	44,317	5,384,693	81,051	10,397,896

[a] 10 pounds.

Ferromanganese and ferrosilicon imported into the United States, 1918–1920, by countries.

[General imports.]

Country.	Alloy.	1918		1919		1920	
		Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.
Canada	Ferromanganese	.....	.....	551	$59,146	203	$16,106
	Ferrosilicon	.....	.....	10,445	629,362	13,885	715,449
England	Ferromanganese	27,162	$4,257,501	32,402	4,215,939	56,128	7,242,252
	Ferrosilicon	.....	.....	.....	.....	19	3,833
Scotland	Ferromanganese	.....	.....	39	6,484	1	349
Japan	Ferromanganese	6	1,244	.....	.....	480	81,455
	Ferrosilicon	5,540	424,932	.....	.....	.....	.....
Cuba	Ferromanganese	.....	.....	30	1,972	.....	.....
France	Ferrosilicon	.....	.....	.....	.....	5	164
British India	Ferromanganese	.....	.....	.....	.....	1,977	336,908
Brazil	Ferromanganese	.....	.....	.....	.....	465	98,208

STEEL.

PRODUCTION, BY STATES AND KINDS.

The following tables showing the production of steel were compiled by the bureau of statistics of the American Iron and Steel Institute. The total for 1920 exceeded 42,000,000 tons, nearly equalling the production of 1916. No data whatever are available on the value of the output of crude steel at the mills, but the weekly issues and annual statistical reviews of the Iron Age give market quotations of prices of steel billets and some of the leading forms of finished steel. The price of Bessemer steel billets at Pittsburgh during 1920 ranged from $43.50 to $62.50 a gross ton; in 1919 it ranged from $38.50 to $46. Tank plates ranged from 2.65 to 3.75 cents a pound in 1920, and from 2.53 to 3 cents a pound in 1919. Steel beams at Pittsburgh ranged from 2.45 to 3.25 cents a pound in 1920, and from 2.45 to 2.80 cents a pound in 1919.

Bessemer steel ingots and castings manufactured in the United States, 1916–1920, in gross tons.

State.	1916	1917	1918	1919	1920
Ohio	4,711,784	4,256,337	3,920,442	3,073,941	3,662,718
Pennsylvania	3,444,163	3,537,094	3,281,941	2,851,402	3,279,023
Illinois	1,958,259	1,763,052	1,229,568	906,324	1,243,837
Other States	944,833	923,477	944,285	439,895	697,509
	11,059,039	10,479,960	9,376,236	7,271,562	8,883,087

Open-hearth steel ingots and castings manufactured in the United States, 1916–1920, in gross tons.

State.	1916	1917	1918	1919	1920
New England States	278,768	332,597	329,630	286,826	290,967
New York and New Jersey	1,872,258	2,110,846	2,245,239	1,296,005	2,010,895
Pennsylvania	16,030,251	16,284,102	15,574,101	12,692,112	14,184,477
Ohio	5,057,751	6,074,857	6,729,955	5,112,616	6,341,016
Indiana	3,243,961	3,722,931	3,910,899	3,122,486	3,785,056
Illinois	1,812,169	1,966,296	2,283,991	1,664,993	2,302,776
Other States	3,120,269	3,657,264	3,385,576	2,773,656	3,756,708
	31,415,427	34,148,893	34,459,391	26,948,694	32,671,895

According to these tables there were increases of 22 per cent in the production of Bessemer steel and of 21 per cent in open-hearth steel in 1920 compared with that of 1919. In the total production of steel there was an increase of nearly 22 per cent. Of the total output in 1920 nearly 78 per cent was represented by open-hearth steel, 21 per cent by Bessemer steel, and more than 1 per cent by all other classes of steel.

Of the total output of open-hearth steel, 31,375,723 gross tons was made by the basic process and 1,296,172 tons by the acid process, compared with 25,719,312 tons of basic and 1,229,382 tons of acid steel in 1919.

PRODUCTION OF STEEL IN ELECTRIC FURNACES.

The production of steel by the electric process in 1920 showed an increase of 31 per cent as compared with 1919.

Steel electrically manufactured in the United States, 1909 to 1920, in gross tons.

Year.	Ingots.	Castings.	Total.	Year.	Ingots.	Castings.	Total.
1909	13,456	306	13,762	1915	46,348	23,064	69,412
1910	50,821	1,320	52,141	1916	126,048	42,870	168,918
1911	27,227	1,878	29,105	1917	239,632	64,911	304,543
1912	14,147	4,162	18,309	1918	403,068	108,296	511,364
1913	20,973	9,207	30,180	1919	272,942	111,510	384,452
1914	15,458	8,551	24,009	1920	346,956	155,196	502,152

In the total production of electric steel in 1920 are included 242,437 tons of alloy-steel ingots and castings which were alloyed with nickel, vanadium, tungsten, chromium, molybdenum, and other metals (233,862 tons of ingots and 8,575 tons of castings), compared with 179,166 tons (175,575 tons of ingots and 3,591 tons of castings) so alloyed in 1919.

On December 31, 1920, the number of completed plants equipped for the manufacture of steel by the electric process was 192, as compared with 165 plants at the end of 1919. On January 1, 1920, it was reported that there were 323 electric furnaces of all types in the United States and 40 in Canada, and at the end of the year these totals had increased to 356 in the United States and 43 in Canada. The total number of furnaces in the world at the beginning and end of 1920 was estimated at 875 and 961, respectively, as compared with 140 in 1913.[14]

[14] Cone, E. F., The status of the electric steel industry: Iron Age, Jan. 6, 1921, pp. 69–72.

TOTAL DOMESTIC PRODUCTION OF STEEL.

Steel produced in the United States, 1810–1920, in gross tons.

Year.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1810–1870	58,482	2,232	146,370		207,084
1871	40,179	1,785	31,250		73,214
1872–1880	4,293,896	245,035	349,730	76,009	4,964,670
1881–1890	21,596,699	2,387,925	703,489	37,044	24,725,157
1891–1900	49,387,341	15,392,764	762,446	35,820	65,578,371
1901–1910	94,048,698	92,418,814	1,051,379	154,683	187,673,574
1911	7,947,854	15,598,650	97,653	31,949	23,676,106
1912	10,327,901	20,780,723	121,517	21,162	31,251,303
1913	9,545,706	21,599,931	121,226	34,011	31,300,874
1914	6,220,846	17,174,684	89,869	27,631	23,513,030
1915	8,287,213	23,679,102	113,782	70,939	32,151,036
1916	11,059,039	31,415,427	129,692	169,522	42,773,680
1917	10,479,960	34,148,893	126,716	305,038	45,060,607
1918	9,376,236	34,459,391	115,112	511,693	44,462,432
1919	7,271,562	26,948,694	63,572	387,404	34,671,232
1920	8,883,087	32,671,895	72,265	505,687	42,132,934

FOREIGN TRADE IN STEEL.

The exports (so far as recorded) of iron and steel increased 15 per cent in quantity and 11 per cent in total value in 1920, as compared with 1919.

Iron and steel imported into the United States, 1918–1920.

Article.	1918		1919		1920	
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.
Scrap iron and steel	63,730	$1,221,752	177,293	$3,249,322	140,645	$2,915,589
Bar iron	1,469	194,597	1,940	220,863	4,987	677,182
Steel ingots, blooms, blanks, and billets	33,612	1,550,175	8,230	440,470	9,299	562,545
Steel bars, mill shafting, castings, etc.	[a] 1,415	[a] 167,050	5,271	612,350	10,394	1,392,667
Steel ingots, blooms, slabs, etc., made by crucible, electric, or cementation process	[b] 4,192 [a] 1,856	[b] 872,429 [a] 1,110,503	2,768	2,795,925	4,540	2,937,388
Rails for railway	8,705	341,985	17,008	651,830	45,684	1,922,409
Sheets and plates	1,517	632,558	1,096	455,559	1,792	589,199
Tin and terne plates	32	5,964	242	66,944	400	130,143
Wire rods	7,677	621,936	341	63,572	5,488	746,953
	124,205	6,718,949	214,189	8,556,835	223,229	11,874,075
Wire and articles made from wire	.....	273,705	.....	463,054	.....	1,440,813
All other manufactures—free	.....	551,304	.....	564,174	.....	2,141,874
All other manufactures—dutiable	.....	4,807,597	.....	3,834,741	.....	7,624,326
	.....	5,632,606	.....	4,861,969	.....	11,207,013
Grand total	.....	12,351,555	.....	13,418,804	.....	23,081,088

[a] 6 months, July to December, 1918.
[b] 6 months, January to June, 1918.

Iron and steel exported from the United States, 1918–1920.

Article.	1918		1919		1920	
	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.	Quantity (gross tons).	Value.
Bar iron	63,367	$6,576,362	60,547	$5,634,398	46,628	$4,651,224
Bars or rods (of steel):						
Wire	148,524	12,469,715	118,010	8,374,716	116,775	8,884,854
All other	579,250	64,575,140	554,212	48,297,598	629,051	53,841,518
Billets, ingots, and blooms, not elsewhere specified	1,786,189	150,568,151	258,424	19,370,787	216,873	12,645,950
Bolts and nuts	28,333	5,687,998	39,743	7,769,893	38,944	7,274,411
Hoops and bands	50,673	7,711,195	50,836	6,875,586	53,449	6,445,155
Horseshoes	2,857	424,208	3,385	539,452	1,834	260,583
Nails:						
Cut	3,823	440,281	2,921	393,284	3,858	573,990
Wire	78,726	9,921,123	89,779	10,744,696	93,179	11,880,398
All other, including tacks	11,792	3,336,570	16,234	4,638,093	12,435	3,068,120
Pipes and fittings:						
Cast iron	55,961	6,665,597	39,455	5,177,752	68,417	9,753,446
Wrought iron	89,982	14,993,957	236,080	35,229,750	284,771	43,774,296
Radiators and cast-iron house-heating boilers	2,857	548,800	4,656	779,259	7,336	1,337,032
Rails for railways, of steel	453,537	26,402,864	652,443	38,986,855	594,628	36,193,689
Railroad spikes	4,649	600,174	24,771	2,896,073	16,601	1,607,672
Scrap and old, fit only for manufacture	2,160	63,626	27,275	717,325	219,250	6,411,534
Sheet and plates:						
Galvanized	68,742	12,609,628	101,637	15,223,289	108,368	16,727,590
Iron	40,756	6,315,095	39,892	4,837,547	32,157	4,036,239
Steel:						
Plates	551,967	64,678,628	710,013	56,701,651	920,059	72,995,717
Sheets	150,028	25,646,749	177,466	21,214,529	169,244	21,199,524
Structural iron and steel	232,792	21,468,452	360,787	28,956,816	493,633	38,384,690
Tin and terne plates	258,538	55,850,294	204,521	36,997,634	226,410	40,545,291
Wire:						
Barbed	235,083	23,492,540	101,451	11,534,297	129,710	16,056,346
All other	157,222	20,704,503	190,212	24,641,881	190,969	25,371,776
	5,057,808	541,751,650	4,064,750	396,533,161	4,674,579	443,921,045
Axes		1,006,848		1,613,862		1,478,935
Hammers and hatchets		484,670		973,547		1,303,185
Railway-track material, switches, frogs, fishplates, splices, bars, etc		5,546,969		9,280,725		7,570,236
Saws		3,790,416		4,851,791		4,455,639
Shovels and spades		680,591		1,398,101		1,294,291
All other tools		9,140,700		14,382,767		16,945,325
		20,650,194		32,500,793		33,047,611
Grand total		562,401,844		429,033,954		476,968,656

PRODUCTION IN PRINCIPAL COUNTRIES.

Steel produced in some principal countries, 1913, 1916–1920, in metric tons.

Country.	1913	1916	1917	1918	1919	1920	Source of data[a]
Australia	[b]	110,144	158,121	[b]	[b]	[b]	1916–1917, 1.
Austria-Hungary	2,625,879	3,330,306	2,920,789	1,763,745	[b]	[b]	1913–1916, 1; 1917–18, 2.
Belgium	2,466,630	99,371	9,530	10,540	333,560	1,252,110	1913–1919, 3; 1920, 4.
Canada	1,060,487	1,295,679	1,583,695	1,699,790	934,706	1,126,728	1913–1919, 5; 1920, 4.
France	4,686,866	1,784,221	1,991,040	1,800,079	[c]2,155,557	[c]3,050,396	1913–1918, 6; 1919, 4; 1920, 7
Germany	[c]18,935,089	[c]16,182,520	[c]16,587,360	[d]14,875,753	[b]	[b]	1913–1918, 1.
India	[b]	133,189	165,134	185,186	[b]	[b]	1916–1918, 1.
Italy	933,500	1,269,486	1,331,641	992,529	731,823	[b]	1913–1919, 8.
Japan	254,951	368,395	370,022	333,431	299,437	[b]	1913–1916, 9; 1917–19, 10.
Russia	4,868,140	[b]	[b]	[b]	[b]	[b]	1913, 11.
Sweden	590,887	614,111	581,000	545,499	491,266	[b]	1913–1919, 12.
United Kingdom	7,786,498	9,343,600	9,960,944	9,744,891	8,020,699	9,200,942	1913–1918, 1; 1919–20, 13.
United States	31,801,688	43,458,059	45,781,577	45,173,831	35,227,705	42,809,168	1913–1920, 14.

[a] 1, National Federation of Iron and Steel Manufacturers (London); 2, Ironmonger; 3, Statistique des industries extractives et métallurgiques; 4, official preliminary; 5, Canada Dept. Mines, Mines Branch; 6, Statistique de l'industrie minérale; 7, consular report; 8, Rivista del servizio minerario; 9, Bur. Foreign and Domestic Commerce; 10, Financial and Economic Annual of Japan; 11, General review of the principal branches of the mining and metallurgical industries (Russia); 12, Bergshantering Sveriges officiella Statistik; 13, Colliery Guardian; 14, American Iron and Steel Institute.

[b] No data available.

[c] Includes Lorraine.

[d] Excludes Lorraine, Saar district, and Luxemburg for November and December.

COBALT.

By Frank L. Hess.

PRODUCTION.

In 1920 cobalt ores were mined only in Missouri, where the Missouri Cobalt Co. recovered 102,410 pounds of cobalt oxide and cobalt hydrate, valued at $262,801, from ore mined at its property near Fredericktown. The company operated only part of the year. In 1919 cobalt ores were mined in Idaho and Missouri. In Idaho the Haynes Stellite Co. produced concentrates carrying approximately 18 per cent of cobalt, and in Missouri the Missouri Cobalt Co. shipped cobalt oxide mined and reduced at its property near Fredericktown. In 1918 cobalt ores were mined only in Idaho, where the Haynes Stellite Co. produced 55 tons of concentrates, carrying 17.74 per cent of cobalt (19,514 pounds), from 4,000 tons of ore.

IMPORTS.

Most of the cobalt used in this country has been imported from Canada, where it is obtained as a by-product from silver ores mined in the Cobalt district.

Cobalt, and cobalt ore, and zaffer, and cobalt oxide imported and entered for consumption in the United States, 1916–1920.

Year.	Cobalt, and cobalt ore, and zaffer.		Cobalt, oxide of.		Total.	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
1916	136,770	$175,236	206,639	$192,009	343,409	$367,245
1917	223,794	369,950	276,406	275,821	500,200	645,771
1918	504,391	628,099	208,596	291,699	712,987	919,798
1919	77,556	144,282	131,424	184,751	208,980	329,033
1920	156,862	331,672	202,724	399,605	359,586	731,277

MOLYBDENUM.

By Frank L. Hess.

PRODUCTION.

So far as the United States Geological Survey has been able to ascertain, there was only one producer of molybdenum in this country in 1920, the Molybdenum Corporation of America, at Questa, N. Mex. The closing of the mines was due to the lack of market.

The corporation produced 1,607 tons of ore, from which were made 84,770 pounds of concentrates carrying 68.62 per cent of MoS_2 (41.17 per cent Mo) that were sold to an allied company, the Electric Reduction Co., of Washington, Pa., for $17,207.[1] At the end of the year 21 tons of concentrates carrying 41.17 per cent of Mo were on hand.

Molybdenum in ore and concentrates produced and sold in the United States, 1915–1920.

Year.	Quantity sold (pounds).	Value.	Year.	Quantity sold (pounds).	Value.
1915	181,769	$114,866	1918	861,637	$1,253,700
1916	206,740	205,000	1919	297,926	341,814
1917	350,200	495,350	1920	34,900	17,207

IMPORTS.

During 1920, 15,639 pounds of molybdenum ore, valued at $9,707, was imported into the United States, against 106,743 pounds, valued at $77,572, in 1919. No record of imports of molybdenum ores was kept by the Bureau of Foreign and Domestic Commerce before July 1, 1918. During the last six months of 1918, 140,222 pounds of ore, valued at $123,924, was imported. It is known that in the first half of the year 25,000 pounds of molybdenite, averaging about 75 per cent of MoS_2, was imported from Chosen and 19,000 pounds from some undesignated part of Asia.

[1] Data published by express permission of the company.

NICKEL.

By Frank L. Hess.

PRODUCTION.

Prior to 1919 the United States produced no nickel from domestic materials except as a by-product of copper refining, as shown in the following table. In 1919, however, the production of nickel was begun from complex sulphides mined on the property of the Missouri Cobalt Co. near Fredericktown, Mo. In 1920 the company produced 80,626 pounds of shot nickel and 256,767 pounds of nickel hydrate, though it did not operate during the whole year. By-product nickel isolated by electrolytic copper refineries amounted to 227 tons, valued at $189,889. Large quantities of nickel matte imported from Canada and smaller quantities of matte from New Caledonian ore are, however, refined in the United States, though only Canadian matte was refined in 1920.

Nickel content of nickel salts and metallic nickel produced in the United States as a by-product in the electrolytic refining of copper, 1915–1920, and from mixed ores in 1919 and 1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1915	822	$538,222	1918	441	$401,000
1916	918	671,192	1919	511	434,485
1917	402	331,556	1920	365	293,250

IMPORTS.

Nickel imported for consumption in the United States, 1916–1920.

Year.	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.		Value of manufactured articles of nickel and nickel sheets and strips.	Total value.
	Quantity (pounds).	Value.		
1916	72,649,377	$9,899,340	$25,880	$9,925,220
1917	75,526,767	9,617,163	45,248	9,662,411
1918	73,207,147	11,520,775	115,243	11,636,018
1919	36,562,388	8,334,135	90,451	8,424,586
1920	48,492,076	10,657,193	200,464	10,857,657

Nickel imported for consumption in the United States, 1919 and 1920, by forms.

Form.	1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.
Nickel ore (nickel content)	10,431,602	$1,959,729	1,541,237	$145,723
Nickel matte (nickel content)	18,871,626	3,820,651	40,044,871	8,318,149
Nickel, alloys, pig, bars, etc	7,258,082	2,553,431	6,905,753	2,193,256
Nickel oxide	1,078	324	215	65
Nickel sheets and strips	10,152	4,889	.....	.....
All other manufactures	87,527	85,562	(a)	200,464
	36,660,067	8,424,586	.....	10,857,657

a Quantity not recorded.

Nickel ore and matte imported into the United States, 1919 and 1920, by countries.

[General imports.]

Country.	Nickel ore and matte.			Manufactures.	
	Quantity (short tons).	Nickel content (pounds).	Value.	Quantity (pounds).	Value.
1919.					
Australia	3,008	3,716,293	$760,887	.....	.....
Canada	22,760	25,503,767	4,997,650	7,303,679	$2,580,695
China	.....	.....	.....	3	2
Denmark	.....	.....	.....	4	17
England	.....	.....	.....	23,607	16,246
France	.....	.....	.....	1,188	5,055
Germany	.....	.....	.....	68	271
Japan	.....	.....	.....	23,777	13,167
Netherlands	.....	.....	.....	11	172
Oceania (French)	56	83,168	21,843	.....	.....
Spain	.....	.....	.....	10	10
Switzerland	.....	.....	.....	3,414	28,247
	25,824	29,303,228	5,780,380	7,355,761	2,643,882
1920.					
Austria	1,210	1,396,001	361,698	.....	5
Belgium	787	857,381	228,242	.....	253
Canada	33,182	37,737,459	7,723,278	.....	2,179,494
Chosen	.....	.....	.....	.....	109
Denmark	.....	.....	.....	.....	39
England	.....	.....	.....	.....	125,108
France	.....	.....	.....	.....	3,594
Germany	.....	.....	.....	.....	23,083
Japan	.....	.....	.....	.....	12,666
Netherlands	.....	.....	.....	.....	66
Oceania (French)	1,389	1,595,267	150,654	.....	.....
Poland and Danzig	.....	.....	.....	.....	*1,324
Sweden	.....	.....	.....	.....	2
Switzerland	.....	.....	.....	.....	49,959
Turkey in Asia	.....	.....	.....	.....	308
	36,568	41,586,108	8,463,872	.....	2,396,010

EXPORTS.

Nickel, nickel oxide, and matte exported from the United States, 1915–1920.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1915	26,418,550	$10,128,514	1918	17,469,500	$6,927,041
1916	33,404,011	12,952,493	1919	3,810,656	1,697,544
1917	21,992,820	8,936,620	1920	1,215,232	574,845

TANTALUM.

By Frank L. Hess.

For several years prior to 1918 there had been no market for tantalum or columbium minerals and they had therefore not been produced. There had, however, been a continuously active interest in research in all lines of metallurgy, and tantalum, as its name suggests, has tantalized the investigator with its attractive qualities, such as resistance to the action of most acids and many other chemicals and of the air, high tensile strength, malleability, and high melting point. In 1918 the demand for tantalum and columbium salts for experimental purposes became large enough to allow A. T. Roos, of Deadwood, S. Dak., to market 4,500 pounds of columbite, valued at $2,250. The columbite, which carried about 50 per cent Ta_2O_5, was taken from the pegmatite dike on the Bob Ingersoll claim (a few miles west of Keystone, S. Dak., on the road to Hill City), and from the Etta and other claims. In 1919 only 300 pounds, valued at $90, was shipped. In 1920 Dr. Roos sold for $1,450 approximately 4,000 pounds of columbite from various pegmatite dikes near Keystone and Custer, S. Dak. The ore was guaranteed to contain 70 per cent of the combined oxides Ta_2O_5 and Cb_2O_5. Analysis of at least one lot showed the Ta_2O_5 content to be somewhat under 40 per cent and the combined oxides to be about 76 per cent.

The ore was all or nearly all made into ferrotantalum-columbium, with no attempt to separate the tantalum and columbium. The ferro was used for experimental purposes.

No tantalum or "tantalum steel-hardening ores" were imported in 1920, and no separate record of exports is kept.

TITANIUM.

By Frank L. Hess.

PRODUCTION.

During 1920 rutile (titanium dioxide, TiO_2) and ilmenite (titanium iron oxide, $TiFeO_3$) were produced in this country only by the American Rutile Co., at Roseland, Nelson County, Va.

Titanium minerals produced in the United States, 1916–1920.

Year.	Rutile concentrates.		Ilmenite concentrates.		Total value.
	Quantity (short tons).	Percentage of TiO_2.	Quantity (short tons).	Percentage of TiO_2.	
1916	110	95	95	55	$18,400
1917	206	93	1,339	53–55	45,637
1918	261	95	1,644	53–55	57,750
1919[a]	102	94–96	106	48–50	22,520
1920	277	94–96	268	50	(b)

[a] Virginia production only; information regarding Florida not available for publication.
[b] Survey not at liberty to publish figures.

Considerable interest has been exhibited, especially during the last two or three years, in the subject of titanium pigments, and the National Lead Co., in its report for the fiscal year ending December 31, 1920, makes the following statement as to its interest in the pigments:

> The National Lead Co., after a year's investigation, in January, 1921, exercised its option to acquire one-half of the outstanding capital stock of the Titanium Pigment Co. (Inc.), having a plant at Niagara Falls, N. Y., engaged in the manufacture of titanium oxide pigment, which it sells under the registered trade name "titanox."
>
> Titanium is a metal widely distributed throughout the earth, but is found in a form relatively easy of treatment in mines controlled by the company near Jacksonville, Fla. This is a new white pigment. It is very interesting in that it has twice the hiding power of pure white lead. Before the National Lead Co. exercised its option it assisted in negotiating a settlement of conflicting patent claims, by the terms of which the Titanium Pigment Co. became the owner of all patent rights in the United States previously owned by the Titan Co., of Norway. Where great hiding power without increase in weight is desired, this pigment should prove to be very valuable. Its cost of manufacture is still high, but it is hoped that, with increased tonnage and improved manufacturing methods, this pigment will soon take its place amongst the best and most marketable white pigments.

The titanium deposits in Florida to which the report refers are those of Buckman & Pritchard (Inc.), on the ocean beach south of Pablo Beach. At this place ilmenite with small quantities of rutile and considerable zircon is concentrated in streaks between extreme

high and low tide levels. As has been noted in previous reports, efforts have been made to extract and market the minerals.

IMPORTS AND EXPORTS.

No titanium or "titanium steel-hardening ores" were imported during 1919 or 1920. The imports of such steel-hardening ores during the last six months of 1918 were 1,606 pounds, valued at $221. No separate record of similar imports was kept prior to July, 1918.

No separate record of exports of titanium, "titanium steel-hardening ores," or ferrotitanium is kept.

TUNGSTEN.

By Frank L. Hess.

GENERAL STATEMENT.

The only tungsten concentrates produced in the United States in 1920 were comparatively small quantities made from ferberite ores in the Boulder field, near Nederland, Colo.

Prices during 1920 were very low, and although the prices publicly quoted in the first part of January were $7 a short ton unit for Chinese wolframite guaranteed to carry 65 per cent or more of WO_3, $9.50 for imported scheelite, and $15 f. o. b. mines for domestic scheelite, these prices were merely nominal; the foreign ores could be bought at least $2 cheaper per unit, and the $15 asked for domestic ore precluded all business, and none was sold at that price.

The hope that Congress would pass a bill placing a high duty on tungsten ores and metal kept the prices asked from dropping as rapidly as they otherwise would have done, but Congress adjourned without final action on the bill.

Ferberite from Rafael Taborga's mine in Bolivia, of which there was several hundred tons in New York, sold in the fall for $6 and later for $5 a unit on account of its purity and freedom from manganese. In the middle of December, however, American scheelite guaranteed to contain 65 per cent or more of WO_3 and to be free from hurtful impurities sold for $3.50 a unit f. o. b. eastern points, in the face of a freight rate of about $50 a ton and other expenses that brought the price down to nearly $2.50 a unit at the mine.

Considering these data prices may fairly be said to have opened at $6 a unit for good wolframite ores (65 per cent or more of WO_3, with less than 0.05 per cent of phosphorus, 0.1 per cent of copper, or 0.1 per cent of tin) and to have declined to $3.50 at the end of the year.

Chinese ore dominated the market during the year, both in the United States and Europe, and, in spite of local taxes, grafts, and profits, movement through a long distance on human shoulders and backs, and steamer shipments over many thousand miles, was still sent to England and the United States even under the lowest prices, and although some who had bought their ores at high prices lost money, others who bought in China under the low prices undoubtedly made money even at the lowest domestic market.

PRODUCTION.

Only two operators are known to have produced tungsten ores in the United States during 1920, the Vasco Mining Co. and the Wolf Tongue Mining Co., both of which operate in the Boulder field, Colorado, and produce ferberite. Both operated in only a small way during a part of the year, and they produced, respectively, 128 tons carrying 58.09 per cent of tungsten trioxide (WO_3) and 119 tons carrying 54.59 per cent WO_3, equivalent to 232 tons of concentrates carrying 60 per cent WO_3, of which 216 tons, valued at about $101,800, was sold and 16 tons remained on hand. Even these two firms could not have operated had they not been subsidiary companies of parent corporations that used the concentrates in making high-speed steel.

The figures are published through the courteous permission of both companies.

Concentrated tungsten ores (carrying 60 per cent of tungsten trioxide) produced and sold in the United States, 1915–1920, and average price per unit.

Year.	Quantity (short tons).	Value.	Average price per unit.	Year.	Quantity (short tons).	Value.	Average price per unit.
1915	2,332	$4,100,000	$29.30	1918	5,061	$7,049,300	$23.24
1916	5,923	12,074,000	33.98	1919	327	353,900	18.02
1917	6,144	6,783,000	18.40	1920	216	101,800	7.86

IMPORTS AND EXPORTS.

Tungsten-bearing ores imported into the United States, 1919 and 1920, by countries.[a]

[General imports.]

1919			1920		
Country.	Quantity (short tons).	Value.	Country.	Quantity (short tons).	Value.
Argentina	145	$111,489	Argentina	86	$64,284
Bolivia	545	213,793	Bolivia	158	85,726
Canada	20	12,750	Chile	148	74,906
Chile	985	685,414	China	420	142,572
China	2,810	1,624,539	Hongkong	859	276,842
Chosen	52	58,375	Japan	128	98,723
Colombia	1	1,312	Mexico	91	12,055
Hongkong	3,403	2,249,011	Panama	13	4,917
Japan	846	856,017	Peru	44	18,765
Mexico	114	104,529	France	1	353
Panama		172	"British Indies"	1	450
Peru	431	299,101			
Straits Settlements	56	44,688			
	9,408	6,261,190		1,949	779,593

[a] The ore from France probably originated in Portugal; that from Panama, Bolivia, Chile, Colombia, and most of that from Peru, is probably from Bolivia; that from China, practically all that from Hongkong, and half of that from Japan is probably from China.

No tungsten ore of domestic production was exported in 1920.

SUPPLY.

Supplies of tungsten ores in the United States, 1916–1920, in short tons.

Year.	Production.	Imports.			Exports.[a]		Apparent consumption plus stocks on hand (accumulated during the year only).[c]
		Ore.	Tungsten and ferrotungsten.	Estimated equivalent in ore carrying 60 per cent of tungsten trioxide.[b]	Tungsten and ferrotungsten.	Estimated equivalent in ore carrying 60 per cent of tungsten trioxide.	
1916	5,923	4,072	43	4,522	287	646	9,799
1917	6,144	4,879	1	5,310	1,162	2,615	8,839
1918	5,061	11,609	.....	12,854	616	1,386	16,529
1919	327	9,408	198	10,915	19	43	11,199
1920	216	1,949	999	4,416	2	5	4,627

[a] No record of tungsten ore exported is at hand, although it is known that some has been shipped abroad.
[b] These items include the ore except Chinese (considered as carrying 65 per cent of tungsten trioxide) and the tungsten and ferrotungsten (considered as equivalent to 2¼ times their weight in ore carrying 60 per cent of tungsten trioxide). Chinese ore imported has been considered as 67.5 per cent of tungsten trioxide.
[c] Production plus imports minus estimated equivalent in ore of the exports of tungsten and ferrotungsten. The apparent consumption is at best only an approximation.

The quantity of ore on hand at the end of the year, including ferrotungsten and tungsten powder, was not exactly known but was very large. Various works held stocks running from a few tons of concentrates to an equivalent of perhaps 2,000 tons of concentrates carrying 60 per cent of WO_3 in concentrates, ferrotungsten, and tungsten powder. Large stocks are piled in various warehouses in and around New York and smaller quantities in other cities. The total quantity is apparently equivalent to between 12,000 and 15,000 short tons of ore carrying 60 per cent of WO_3.

RADIUM, URANIUM, AND VANADIUM.

By Frank L. Hess.

PRODUCTION.

The output of uranium and vanadium ores in 1920 is estimated at 35,076 short tons containing 143.5 tons of uranium (338,240 pounds of U_3O_8), 526.7 tons of vanadium (1,819,535 pounds of V_2O_5), and about 43.4 grams of radium. The approximate value, as ore, was probably about $2,401,000. About 32.539 grams of radium in various salts was isolated during the year. The output of uranium and vanadium ores in 1919 amounted to about 14,509 short tons containing 28.96 grams of radium, 95.73 tons of uranium (225,704 pounds of U_3O_8), and 284.2 tons of vanadium. The approximate value as ore in 1919 was probably about $1,630,900. Any value given to the output must be arbitrary and open to question, for the larger part of the uranium ores was produced by companies that themselves used the ores. Vanadium ore was produced at Placerville and Vanadium, Colo., by the Vanadium Corporation of America (which had bought the mines and business of the Primos Chemical Co.) and by the Colorado Vanadium Co. Owing to the very high price of vanadium, ores from the Paradox Valley and Gateway districts of Colorado and the La Sal Mountains, Utah, that ran high in vanadium but low in uranium, were shipped for their vanadium content.

During the year the Carnotite Reduction Co., of Chicago, was absorbed by the Radium Co. of Colorado, and the Tungsten Products Co. of Boulder purchased the large group of carnotite claims known as the Kearns-Clark claims on Dry Wash, south of the La Sal Mountains, Utah.

A sampling plant for carnotite ores was built by the Radium Ore Sampling Co. at Montrose, Colo.

SOURCES OF SUPPLY.

More than half of the world's vanadium comes from Peru, and most of the remainder comes from the roscoelite and carnotite fields of southwestern Colorado and southeastern Utah. Small quantities of dechenite and other oxidized vanadium minerals have also been obtained in New Mexico, Nevada, and Arizona. A little mottramite has been mined in the former German East Africa, now under British control, and some ore has been reported from other parts of southern Africa; tyuyamunite, a calcium carnotite, has been mined in Russian Turkestan and treated at Petrograd; and vanadium has from time to time been extracted from the French iron slags.

The United States, as the largest steel-making country, is the largest user of vanadium. England, Germany, and France buy ferrovanadium from this country and at times also buy ores.

The great patronite deposit at Minaragra, Peru, the largest known deposit of vanadium, is owned by an American company, the Vanadium Corporation of America, but of course the political control is wholly in the hands of Peru.

Announcement was made during the year of plans for development by the Baja California Vanadium Co. of calcium vanadate deposits near Angeles Bay, Lower California,[1] but no further details have come to hand. Vanadium (roscoelite) deposits were also reported from the White Cliffs near Telluride and on Mount Wilson, Colo., but the deposits found seem to have been small. The discovery of torbernite, hydrous copper uranium phosphate, at White Signal, N. Mex., was announced during the year. The discovery was made on claims that for years had been worked for gold by Otto Forster and Jack Grissom. An option on the property was taken by the Radium Co. of Colorado, and considerable exploratory work was done, but not enough torbernite could be found to make a valuable radium ore, even with hand picking.

A. A. Leach [2] reported that ores from the old camp of Black Hawk (Bullards Peak), N. Mex., show considerable radioactivity that is supposed to come from pitchblende,[3] though no pitchblende can be seen in the material.

WORLD'S PRODUCTION.

The exports from Peru, as shown by the Peruvian official publications, and the production in the United States since 1916 have been as follows:

Approximate world's production of vanadium, 1916–1920.

Year.	Peru (exports of ore).			United States (production of ore and concentrates).
	Quantity (short tons).	Percentage of V_2O_5.	Vanadium contained (short tons).	Vanadium contained (short tons).
1916	3,801	40.00	851	460
1917	4,501	35.78	902	484
1918	2,407	19.10	257	276
1919	3,249	30.41	553	284
1920	(a)	(a)	1,224	527

a Figures not yet available.

NEW YORK STATE BUYS RADIUM.

What is hoped to be and probably is the far-visioned beginning of a movement among States and other units of government to place the curative properties of radium within the reach of their citizens was made by the State of New York in the purchase of 1,997.81 milligrams of radium for the use of the State Institute for the Study of Malignant Disease. The radium was bought through sealed bids opened July 1, 1920, from the Radio Chemical Corporation of New York City, a subsidiary of the Radium Luminous Materials Corporation, at $89,000 a gram. The first gram was shipped to the United States Bureau of Standards for measurement July 9.

[1] Eng. and Min. Jour., vol. 110, p. 921, 1920.
[2] Private communication.
[3] Leach, Mrs. A. A., Torbernite and other radium ores: Southwestern Mag., Silver City, vol. 4, p. 18, April, 1920.

The institute began research work on cancer in 1898 and is said to be the oldest institution of the kind in the world and the first established by any State or Government, but it is to be hoped that there will be many more.

The radium will all be placed in solution and the emanation will be used in the treatment of disease under scientific conditions.

The work of this institute is research work, and the purposes of the institute will be to study the effects of radium upon malignant and other diseases, to determine its limitations, improve its usefulness, and to obtain and publish accurate records in the interest of science.

The radium is the property of the State, and its use will be free not only to citizens of New York State but to any suitable cases which, in the opinion of the director, should be treated from outside of the State, even foreign countries.[4]

IMPORTS AND EXPORTS.

Uranium salts and oxide, including some radium salts, imported for consumption in the United States, 1915–1920.

Year.	Value.	Year.	Value.
1915	$17,288	1918	[a] $274
1916	5,065	1919	[b] 12,960
1917	2,930	1920	[c] 3

[a] Radium salts only.
[b] Composed of the value of 154 pounds of uranium salts and oxide ($1,309) and of 13 grains of radium salts ($11,651).
[c] Uranium salts only.

The imports of "vanadium steel-hardening ores" for consumption in the United States in 1920 were 20,673,296 pounds, valued at $1,080,935, and in 1919 were 6,026,005 pounds, valued at $67,846. Vanadium ore imported during the last six months of 1918 amounted to 1,772,215 pounds, valued at $5,333. No separate record was kept prior to July, 1918. The imports of "uranium-radium steel-hardening ore" in 1920 were 396 pounds, valued at $1,110. There were no imports of such ore in 1919, but 157 pounds, valued at $4,840, was imported in 1918.

No separate record is kept of vanadium exports.

[4] Gaylord, H. R., director, personal communication, Oct. 18, 1920.

QUICKSILVER.

By F. L. Ransome.

STATISTICAL SUMMARY.

Quicksilver produced in the United States in 1920.

State.	Ore treated (short tons).	Percentage tenor won.	Quantity (flasks of 75 pounds).	Value.
California	87,960	0.41	[a] 9,849	$784,571
Texas	20,770	.62	3,436	273,712
Nevada	[b] 400	.78	83	6,612
Oregon	100	.90	24	1,912
	109,230	.46	13,392	1,066,807

[a] Includes 234 flasks obtained by washing and not considered in calculating percentage tenor.
[b] Estimated.

Average price per flask:	
San Francisco	$79.66
New York	81.12
London	£20 14s. 9d.
Number of mines producing	17

Decrease in production in 1920 from 1919, 8,023 flasks.
Exports from the United States, 116,493 pounds or 1,553 flasks.
Imports into the United States, 1,062,647 pounds or 14,169 flasks.
Apparent consumption of quicksilver in the United States (domestic production plus imports minus exports), 26,008 flasks.

INTRODUCTION.

The decline in mining activity and in the production of quicksilver, which was conspicuous in 1919, was strikingly emphasized in the later part of 1920 by the closing of all but two of the important productive mines. At the end of the year the New Almaden mine in California and the Chisos mine in Texas, with a total production for the year of less than 5,500 flasks, were the only mines in operation whose normal output exceeds 100 flasks annually. The output of 1920, 13,392 flasks, is the lowest on record since 1860, and the output for 1921 is likely to fall below the 7,723 flasks of 1850, the year in which significant production began.

The immediate cause of the collapse of the quicksilver mining industry in 1920 was the sharp drop in price per flask from an average of $71 in October to $56 in November; in December the average price fell to $52.50, and throughout 1921 it has remained generally below $50. With the cost of supplies still much higher than in pre-

war years the low-grade quicksilver ores of the United States can not be profitably mined and treated for a price of $50 per flask of quicksilver. The Chisos ore, although of lower grade than formerly, is still much above the average grade of quicksilver ore worked in the United States.

The apparent consumption of quicksilver in the United States in 1920 was 26,008 flasks, an increase over that of 1919; but the exports were much smaller than in 1919, and the imports larger (see p. 428), although the rather widely published statement that the imports for 1920 amounted to more than 16,000 flasks is not supported by the records of the Bureau of Foreign and Domestic Commerce. The condition of foreign exchange made it easy for foreign quicksilver to compete in our market with the domestic product; indeed, some Italian quicksilver is reported to have been sold in New York for as low as $35 per flask. The same condition of exchange which made the United States a favorable place wherein to dispose of foreign quicksilver operated against the sale of American quicksilver in foreign markets. The disadvantages under which the American quicksilver miner works in comparison with Spanish and Italian producers are the combined result of unfavorable foreign exchange, high working costs, and the low tenor of his ore. Inasmuch as the average grade of ore worked in the United States was formerly much higher, the last-mentioned condition is practically equivalent to the statement that the best of the known ore bodies in this country have been exhausted and that most of the mines are reduced to material which is below the average grade of the principal foreign deposits and which, under present conditions in the United States, contains too little quicksilver to be workable at a profit. In other words, it is not ore.

Although the apparent consumption of quicksilver in the United States was larger in 1920 than in 1919, there was comparatively little demand for the metal during the later part of the year, and the manufacturers of mercurial products apparently had considerable stocks of their preparations on hand.

The Geological Survey report on quicksilver in 1917, which may still be had upon application, contains much information, particularly concerning foreign resources, the mineralogy of quicksilver ores, and the costs of producing quicksilver, that has not been repeated in the present report. It also contains a bibliography of quicksilver in North America. The report for 1918, also obtainable, contains a descriptive list of the quicksilver mines in the United States.

PRODUCTION.

WORLD'S PRODUCTION.

In the accompanying table are given the best figures available for the world's production of quicksilver in recent years. The foreign figures, generally published in metric tons, are calculated to flasks of 75 pounds net by multiplying by the factor 29.395. This table represents a complete revision of that published in the report for 1919. Russia has been dropped from the named producing countries, and the output from territory formerly embraced within the Russian Empire has been included within the necessarily roughly estimated

total for "other countries." On the other hand, Mexico has been added, as official figures of production have become available and the output of that country is of particular interest to producers in the United States. The official statistics show that Mexico, during some years, produced more quicksilver than had been previously estimated. Czechoslovakia has also been added, as containing the former Hungarian deposits.

So far as possible the figures in the table are taken from official statistical publications of the respective countries. Where no trustworthy official data were obtainable the output has been estimated on such miscellaneous information as could be collected. For Austria and Hungary no official statistics have been obtainable since the outbreak of the World War. The lack for Austria, however, has been supplied by a paper on the Idria mine by Castelli. (See p. 435.) He gives a table of the production of the mine from 1900 to 1918. His figures thus overlap the period for which official Austrian statistics are available, and as the agreement is close it may fairly be concluded that his table is based on mine records and that the Austrian output for many years practically all came from Idria. The output of Venezia Giulia, the Italian province that now contains this famous mine, has been published, for 1919, by the Italian Government. So far as known the quantity given all came from Idria. Austria at present produces no quicksilver.

Hungarian quicksilver, as described in the report on quicksilver in 1917, has been produced chiefly as a by-product from sideritic iron ores mined near Iglo, in northern Hungary. No strictly official figures are available for the years following 1913 but the figures published in the periodical Montanistische Rundschau, of Vienna, were apparently derived from official sources. The deposits are now in Czechoslovakia, and Hungary is no longer a quicksilver-producing country. The increased production of Spain as compared with 1918 shows that the Almaden mine is again yielding quicksilver at its normal rate. Some additional details of foreign production will be found under "Notes on foreign quicksilver deposits," on pages 434 to 437.

Inspection of the table of world's production shows in some respects a return to pre-war conditions. In 1919 Spain led, as in 1913, with more than 36,000 flasks; Italy took her former second place; and the United States, as formerly, came third, with an output only slightly greater than in 1913. It is to be remembered, however, that the Italian output for 1919 includes the quicksilver from the Idria mine, which in 1913 amounted to 24,104 flasks. The output from Italy therefore, when normal production at Monte Amiata and Idria is restored, is likely to be between 50,000 and 60,000 flasks, which will make her by long odds the leading quicksilver-producing country.

World's production of quicksilver, 1910–1919, in flasks of 75 pounds and in metric tons.

[1 metric ton=29.395 flasks.]

Country.	1910		1911		1912	
	Flasks.	Metric tons.	Flasks.	Metric tons.	Flasks.	Metric tons.
United States	20,601	700.8	21,256	723.1	25,064	852.7
Spain [a]	32,891	1,118.9	43,912	1,493.9	36,921	1,256.0
Italy [b]	26,264	893.5	28,072	955.0	29,401	1,000.2
Austria	17,716	[c] 602.7	20,697	[c] 704.1	22,417	[c] 762.6
Hungary	2,641	[f] 89.8	2,339	[f] 79.6	2,499	[f] 85.0
Czechoslovakia						
Mexico [j]	7,367	250.6	4,853	165.1	4,857	165.2
Other countries [k]	1,000	34.0	900	30.6	1,100	37.4
	108,480	3,690.3	122,029	4,151.4	122,259	4,159.1

Country.	1913		1914		1915	
	Flasks.	Metric tons.	Flasks.	Metric tons.	Flasks.	Metric tons.
United States	20,213	687.6	16,548	562.9	21,033	715.5
Spain [a]	36,619	1,245.7	28,000	952.5	35,925	1,222.2
Italy [b]	29,513	1,004.0	31,541	1,073.0	28,954	985.0
Austria	24,104	[c] 820.0	25,873	[d] 880.2	22,340	[d] 760.0
Hungary	2,610	[f] 88.8	2,213	[g] 75.3	1,861	[g] 63.3
Czechoslovakia						
Mexico [j]	4,872	165.7	4,774	162.4	2,763	93.9
Other countries [k]	1,100	37.4	1,100	37.4	1,500	51.0
	119,031	4,049.2	110,049	3,743.7	114,376	3,890.9

Country.	1916		1917		1918		1919	
	Flasks.	Metric tons.	Flasks.	Metric tons.	Flasks.	Metric tons.	Flasks.	Metric tons.
United States	29,932	1,018.3	36,159	1,230.1	32,883	1,118.6	21,415	728.5
Spain [a]	23,367	794.9	25,147	855.5	16,677	567.3	36,055	1,226.6
Italy [b]	32,140	1,093.4	31,494	1,071.4	30,512	1,038.0	24,839	845.0
Austria	12,064	[d] 410.4	19,066	[d] 648.6	12,346	[d] 420.0	[e]	[e]
Hungary	2,352	[h] 80.0	2,781	[g] 94.6	2,352	[h] 80.0	[i]	[i]
Czechoslovakia							2,352	[h] 80.0
Mexico [j]	1,543	52.5	974	33.1	4,809	163.6	3,496	118.9
Other countries [k]	1,500	51.0	1,000	34.0	1,000	34.0	1,000	34.0
	102,898	3,500.5	116,621	3,967.3	100,579	3,421.5	89,157	3,033.0

[a] Estadística minera de España, Madrid.
[b] Riv. servizio min.. Roma. Includes, for 1919, the output from Idria, previously credited to Austria.
[c] Statistik das Bergbaues in Osterreich, Wien.
[d] Castelli, Gaetano, La mina de mercurio de Idria: Rev. minera, metalúrgica y de ingeniería, Madrid, Aug. 24, 1921.
[e] Output of Idria mine credited to Italy.
[f] Ungar. statist. Jahrb., Budapest.
[g] Montanistische Rundschau, Wien.
[h] Statistics not available; estimate only.
[i] Deposits now in Czechoslovakia.
[j] Bol. minero, Dept. de Minas, Mexico.
[k] Estimated as flasks and quantity in metric tons calculated therefrom.

DOMESTIC PRODUCTION.

Seventeen mines reported production in 1920, against 34 in 1919. Of these 17, at least 4 appear to have made their small outputs entirely from dumps or from cleaning-up operations in their metallurgical plants. A large part of the quicksilver produced came from mines at which operations ceased near the end of the year. Among

these may be mentioned the New Idria, New Guadalupe, Oceanic, Cloverdale, Helen, Oat Hill, and Carson (Klau), in California, and the Big Bend, in Texas. Of the mines productive during the year, 11 are in California, 2 in Nevada, 1 in Oregon, and 3 in Texas.

According to reports to the Geological Survey from individual mining companies or mine operators, the output of quicksilver in the United States in 1920 was 13,392 flasks of 75 pounds each, against 21,415 flasks in 1919 and 32,883 flasks in 1918.

At the average price for the year, $79.66 a flask, based on quotations for domestic quicksilver in San Francisco published weekly in the Mining and Scientific Press, the value of the output in 1920 was $1,066,807, a decrease of $866,753 from 1919. The producers of 8,882 of the 13,392 flasks gave in their statistical reports the value of their product. On the supposition that this was in general the amount received from sales, it corresponds to an average value of $90.67 a flask, or about $11 more than the average quotation in San Francisco. This probably means that the greater part of the output was produced and sold before the rapid decline in price in the later part of the year.

Quicksilver produced in the United States, 1915–1920.

State.	1915		1916		1917	
	Quantity (flasks).	Value.	Quantity (flasks).	Value.	Quantity (flasks).	Value.
Arizona			5	$629	40	$4,213
Oregon	4,423	$379,493	[a] 378	47,587	388	40,864
Texas			6,306	793,862	10,791	1,136,508
California	14,283	1,225,481	21,045	2,649,355	23,938	2,521,151
Nevada	2,327	199,657	2,198	276,706	997	105,004
Idaho					5	526
	21,033	1,804,631	29,932	3,768,139	36,159	3,808,266

State.	1918		1919		1920	
	Quantity (flasks).	Value.	Quantity (flasks).	Value.	Quantity (flasks).	Value.
Arizona						
Oregon	702	$82,485	435	$39,276	24	$1,912
Texas	8,451	992,992	5,019	453,166	3,436	273,712
California	22,664	2,663,020	15,205	1,372,859	9,849	784,571
Nevada	1,044	122,670	756	68,259	83	6,612
Idaho	22	2,585				
	32,883	3,863,752	21,415	1,933,560	13,392	1,066,807

[a] Includes 75 flasks from Washington.

Quicksilver produced in the United States, 1850–1920.

[In flasks of 76.5 pounds to June, 1904; subsequently in flasks of 75 pounds.

Year.	Flasks.	Average price per flask.	Value.	Year.	Flasks.	Average price per flask.	Value.
1850	7,723	$99.45	$768,052	1887	33,825	$42.375	$1,433,334
1851	27,779	66.93	1,859,248	1888	33,250	42.50	1,370,625
1852	20,000	58.33	1,166,600	1889	26,484	45.00	1,191,780
1853	22,284	55.45	1,235,648	1890	22,926	52.50	1,203,615
1854	30,004	55.45	1,663,722	1891	22,904	45.25	1,036,406
1855	33,000	53.55	1,767,150	1892	27,993	40.71	1,139,595
1856	30,000	51.65	1,549,500	1893	30,164	36.75	1,108,527
1857	28,204	48.73	1,374,381	1894	30,416	30.70	933,771
1858	31,000	47.83	1,482,730	1895	36,067	37.04	1,335,922
1859	13,000	63.13	820,690	1896	30,765	34,96	1,075,544
1860	10,000	53.55	535,500	1897	26,691	37.28	995,040
1861	35,000	42.05	1,471,750	1898	31,092	38.23	1,188,647
1862	42,000	36.35	1,526,700	1899	30,454	47.70	1,452,656
1863	40,531	42.08	1,705,544	1900	28,317	44.94	1,272,566
1864	47,489	45.90	2,179,745	1901	29,727	48.46	1,440,570
1865	53,000	45.90	2,432,700	1902	34,291	43.20	1,481,371
1866	46,550	53.13	2,473,202	1903	35,634	45.29	1,613,864
1867	47,000	45.90	2,157,300	1904	35,315	43.50	1,536,203
1868	47,728	45.90	2,190,715	1905	30,534	36.22	1,105,941
1869	33,811	45.90	1,551,925	1906	26,083	39.50	1,030,279
1870	30,077	57.38	1,725,818	1907	21,554	39.60	853,538
1871	31,686	63.10	1,999,387	1908	19,752	44.17	872,446
1872	31,621	65.93	2,084,773	1909	21,075	45.45	957,859
1873	27,642	80.33	2,220,482	1910	20,601	46.51	958,153
1874	27,756	105.18	2,919,376	1911	21,256	46.01	977,989
1875	50,250	84.15	4,228,538	1912	25,064	42.05	1,053,941
1876	72,716	44.00	3,199,504	1913	20,213	40.23	813,171
1877	79,395	37.30	2,961,434	1914	16,548	49.05	811,680
1878	63,880	32.90	2,101,652	1915	21,033	85.80	1,804,631
1879	73,684	29.85	2,199,467	1916	29,932	125.89	3,768,139
1880	59,926	31.00	1,857,706	1917	36,159	105.32	3,808,266
1881	60,851	29.83	1,815,185	1918	32,883	117.50	3,863,752
1882	52,732	28.23	1,488,624	1919	21,415	90.29	1,933,560
1883	46,725	28.75	1,343,344	1920	13,392	79.66	1,066,807
1884	31,913	30.50	973,347				
1885	32,073	30.75	986,245		2,372,820	.....	115,572,197
1886	29,981	35.50	1,064,325				

QUANTITY AND TENOR OF ORE MINED AND TREATED.

With declining output it has become increasingly difficult to obtain satisfactory statistics of the quantity of ore mined and treated. When cessation of operations becomes imminent mining is apt to become unsystematic and records are loosely kept or omitted, particularly by the smaller producers. The returns from the larger mines in California and Texas were, however, with one or two exceptions, fairly complete. Apparently very little ore was treated in retorts in 1920, and as the retorting operator is, as a rule, more haphazard as regards records of quantity than the furnace operator, this decrease in retorting has compensated to some extent the deficiencies of the small furnace operator.

The total quantity of quicksilver ore mined in the United States in 1920, in small part estimated, appears to have been about 112,400 short tons. The ore treated in furnaces amounted to 108,530 tons, which yielded 13,067 flasks of quicksilver. This was at the rate of 0.45 per cent, or 9 pounds of quicksilver to the ton of ore, whereas in 1919 the average yield of furnace ore was 0.43 per cent, or 8.6 pounds to the ton. In view of the incompleteness of the records of quantity in 1918 and 1919 this difference is too small to have much significance. At New Almaden 234 flasks was recovered by hand washing material excavated from the sites of old furnaces and condensers, but the quantity of material treated was not recorded.

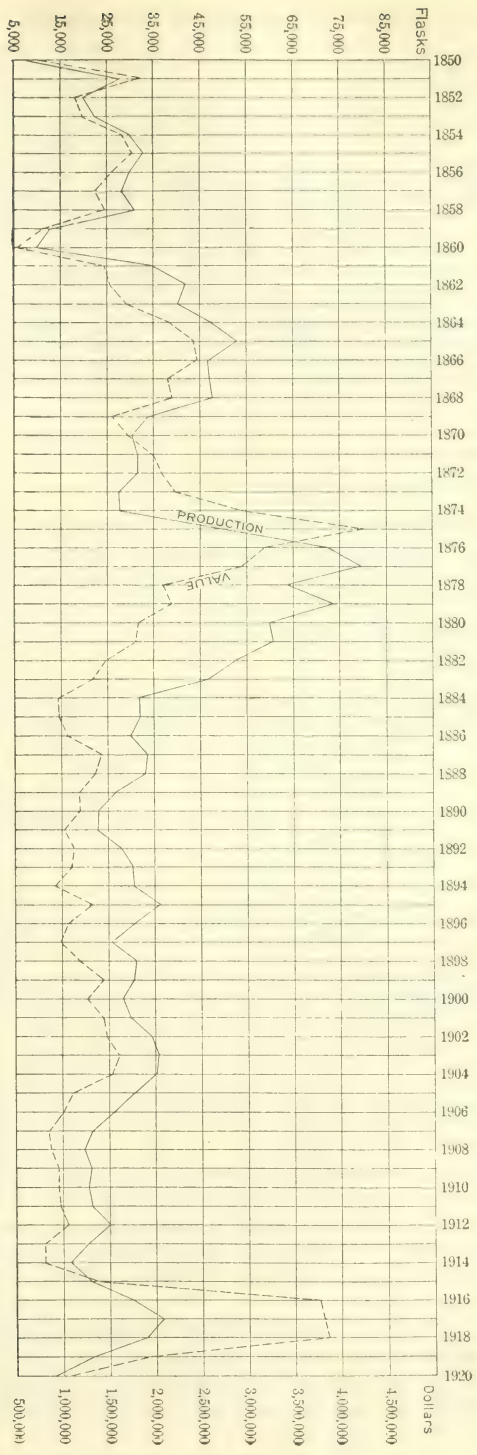


FIGURE 12.—Diagram showing quantity and value of quicksilver produced in the United States from 1850 to 1920.

Quicksilver ore treated and metal won in the United States, 1917–1920.

State.	1917			1918			1919			1920		
	Ore treated (short tons).	Metal won (pounds per ton).	Percentage tenor won.	Ore treated (short tons).	Metal won (pounds per ton).	Percentage tenor won.	Ore treated (short tons).	Metal won (pounds per ton).	Percentage tenor won.	Ore treated (short tons).	Metal won (pounds per ton).	Percentage tenor won.
Arizona	79	38.0	1.90									
Oregon	12,732	[a] 2.3	[a] .11	13,034	4.0	0.20	[b] 5,160	6.4	0.32	100	18.0	0.90
Texas	28,242	28.4	1.42	36,482	17.4	.87	38,864	9.6	.48	20,770	12.4	.62
California	235,786	7.6	.38	355,000	4.8	.24	138,019	8.2	.41	[c] 87,960	8.2	.41
Nevada	3,639	20.4	1.02	11,078	7.0	.35	[b] 6,630	8.6	.43	[b] 400	15.6	.78
Idaho	6	62.4	3.12	60	27.4	1.37						
	280,484	9.6	.48	415,654	6.0	.30	188,673	8.4	.42	109,230	9.2	.46

[a] These figures are abnormally low, owing to accumulation of unworked soot.
[b] Estimated.
[c] Includes estimate of 200 tons for retorted ore.

The table below shows the relative importance of furnaces and retorts in the production of domestic quicksilver. The furnaces are preponderantly of the Huttner-Scott type, but recently a large part of the output has come from rotary furnaces of the Gould type. The retorts are chiefly of the horizontal pipe form, but include also some of the D pattern.

Quicksilver ore treated in furnaces and retorts in United States in 1920.[a]

State.	Ore treated (short tons).		Quicksilver won (flasks).		Percentage tenor won.	
	Furnaces.	Retorts.	Furnaces.	Retorts.	Furnaces.	Retorts.
California	87,760	No record.	9,557	58	0.41	
Texas	20,770		3,436		.62	
Other States [b]	No record.	No record.	74	33		
	108,530		13,067	91	.45	

[a] In addition, in California, 234 flasks was obtained by hand-washing material containing quicksilver in the metallic state. This metal had been lost in previous metallurgical operations.
[b] Includes Oregon and Nevada.

METHODS OF PRODUCTION.

The volume on "The quicksilver resources of California," by W. W. Bradley, published in 1918 as Bulletin 78 of the California State Mining Bureau, treats extensively of the metallurgy of quicksilver ores and should be consulted by those interested in this subject. The results of the investigations of the United States Bureau of Mines, referred to in the report for 1917, have also appeared in part as Technical Paper 96, "Fume and other losses in condensing quicksilver from furnace gases," by L. H. Duschak and C. N. Shuette, published in 1919.

The ores of quicksilver, unlike those of most metals that are won by smelting, are without exception in this country treated at the mines, and the liquid metal is shipped as a finished commercial product. Methods of treatment have been briefly described in the reports for 1917, 1918, and 1919.

PRICES.

The average domestic price of quicksilver was lower in 1920 than for any other year since 1914. With moderate fluctuations, the price continued above $80 until the latter part of the year, when it dropped rather rapidly to $52.50.

The prices given in the following table have been obtained by averaging the weekly quotations published in the Mining Journal for London, the Engineering and Mining Journal for New York, and the Mining and Scientific Press for San Francisco, the primary domestic market. As the figures prior to 1913, however, are not complete in the Mining and Scientific Press, they have been taken, for the years 1909–1912, from the Engineering and Mining Journal. Obviously, the figures given in this table, being annual averages, may differ considerably from the price actually quoted or obtained on a particular date.

Average yearly prices of quicksilver in the United States and the United Kingdom from 1909 to 1920, inclusive.

[Per flask of 75 pounds.]

Year.	San Francisco [a] (domestic).	New York.[b]	London.[c]	Year.	San Francisco [a] (domestic).	New York.[b]	London.[c]
			£ s. d.				£ s. d.
1909	$45.45	$46.30	8 12 0	1915	$85.80	$87.01	14 10 8
1910	46.51	47.06	8 16 0	1916	125.89	125.49	17 2 10
1911	46.01	46.54	8 4 11	1917	105.32	106.30	22 4 3
1912	42.05	42.46	8 2 10	1918	117.50	123.47	(e)
1913	40.23	39.54	7 9 2	1919	90.29	92.15	20 9 5½
1914	49.05	48.31	[d] 7 15 0	1920	79.66	81.12	20 14 9

[a] Min. and Sci. Press, San Francisco.
[b] Eng. and Min. Jour., New York.
[c] Min. Jour. (London).
[d] Metal exchange closed about three months after outbreak of war. Average based on 37 weeks only.
[e] Quoted as "nominal" only.

Although San Francisco is commonly referred to as the "primary market" for quicksilver in the United States, from the fact that the greater part of this metal produced in the country comes from the Pacific coast and goes through the hands of San Francisco firms, yet it should be noted that that city is not a market in the same sense as New York. Most of the quicksilver that passes nominally through San Francisco is handled on commission and is sold in New York, which consequently is the great distributing point of quicksilver to the actual customers.

Price of domestic quicksilver at San Francisco, 1918–1920.

[Per flask of 75 pounds.]

Month.	1918	1919	1920	Month.	1918	1919	1920
January	$128.06	$103.75	$89.00	July	$120.00	$100.00	$88.00
February	118.00	90.00	81.00	August	120.00	103.00	85.00
March	112.00	72.80	87.00	September	120.00	102.60	75.00
April	115.00	73.12	100.00	October	120.00	86.00	71.00
May	110.00	84.80	87.00	November	120.00	78.00	56.00
June	112.00	94.40	85.00	December	115.00	95.00	52.50

IMPORTS AND EXPORTS.

The import duty on quicksilver from 1890 to 1895 was 10 cents a pound; from 1895 to 1913 it was 7 cents. The Underwood tariff bill, enacted in 1913 and still in force, made the duty 10 per cent ad valorem, which, at the average price in London for 1920, at the average exchange for the year, $3.65, would be equivalent to an import tax of about 10 cents a pound.

In the following tables [1] are given imports of quicksilver for domestic consumption, total annual exports, and annual exports by countries. In 1920 the imports were greater by 265,034 pounds, or about 3,534 flasks, than in 1919, and the increase in the total value of the imports was $180,284. In 1919 the increase of imports as compared with 1918 was 3,916 flasks. The exports in 1920 show a decrease of 566,511 pounds, or about 7,554 flasks. About 57 per cent of the quicksilver exported went to Japan and 29 per cent to Canada.

Quicksilver imported and entered for consumption in the United States, 1911–1920.

Year.	Quantity.			Value.
	Pounds.	Metric tons.	Approximate equivalent in flasks of 75 pounds.	
1911	471,944	214.07	6,292	$251,386
1912	82,706	37.52	1,103	39,920
1913	171,653	77.86	2,289	75,361
1914	614,869	278.90	8,198	271,984
1915	421,884	191.37	5,625	282,752
1916	424,396	192.50	5,659	515,919
1917	390,494	177.13	5,207	448,032
1918	503,907	228.57	6,719	533,622
1919	797,613	361.79	10,635	791,226
1920	1,062,647	482.01	14,169	971,510

Quicksilver exported from the United States, 1911–1920.

Year.	Quantity.			Value.
	Pounds.	Metric tons.	Approximate equivalent in flasks of 75 pounds.	
1911	21,841	9.91	291	$13,995
1912	23,283	10.56	310	13,360
1913	85,521	38.79	1,140	43,574
1914	108,426	49.18	1,446	70,753
1915	252,852	114.69	3,372	225,509
1916	666,027	302.11	8,880	670,475
1917	808,336	366.66	10,778	998,470
1918	232,346	105.39	3,098	338,620
1919	683,004	309.80	9,107	817,328
1920	116,493	52.84	1,553	129,993

[1] Compiled by J. A. Dorsey, of the U. S. Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Domestic quicksilver exported from the United States, 1919–1920, by countries.

	1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.
Europe:				
Denmark	11,200	$21,300	.....	.....
Greece	45	75	.....	.....
Norway	3,000	4,750	.....	.....
Sweden	29,750	43,571	.....	.....
North America:				
Canada	18,827	24,745	33,743	$38,459
Mexico	991	1,185	782	962
Newfoundland and Labrador	.....	.....	75	100
Central America:				
Costa Rica	.....	.....	75	88
Guatemala	75	120	25	40
Honduras	225	260	.....	.....
Nicaragua	150	130	1,203	1,483
Panama	.....	.....	60	90
Salvador	375	668	450	540
West Indies:				
British—				
Trinidad and Tobago	10	20	.....	.....
Other	2	4	.....	.....
Cuba	1,084	1,705	1,449	1,596
Dominican Republic	25	53	.....	.....
Haiti	3	7	10	19
South America:				
Argentina	306	348	1,005	1,235
Bolivia	14	13	.....	.....
Brazil	911	1,350	300	384
Chile	1,827	2,225	1,157	1,481
Colombia	2,568	3,510	766	947
Ecuador	10	22	70	85
Guiana—				
Dutch	75	75	.....	.....
French	1,105	1,424	150	186
Peru	2,200	2,359	1,275	1,501
Uruguay	75	175	.....	.....
Venezuela	275	456	336	378
Asia:				
China	1,129	1,193	435	513
Chosen (Korea)	404	525	1,411	1,454
Hongkong	181,700	212,240	75	88
India (British)	3,750	3,250	3,675	4,508
Japan	417,710	485,745	66,000	71,475
Russia in Asia	75	100	150	200
Straits Settlements	12	12	.....	.....
East Indies, Dutch	1,961	2,324	675	860
Oceania:				
Australia	.....	.....	176	170
French (New Caledonia)	1	2	.....	.....
New Zealand	150	170	.....	.....
Philippine Islands	534	629	965	1,151
Africa:				
British South Africa	450	588	.....	.....

USES OF QUICKSILVER.

The uses of quicksilver, which are exceedingly varied, have been rather fully described in previous reports, which are still available for distribution.

SUPPLIES.

Supplies of quicksilver in the United States, 1913–1920.

Year.	Production.		Imports.		Exports.		Apparent consumption.	
	Quantity (flasks).	Value.	Quantity (flasks).	Value.	Quantity (flasks).	Value.	Quantity (flasks).	Value.
1913	20,213	$813,171	2,289	$75,361	1,140	$43,574	21,362	$844,958
1914	16,548	811,680	8,198	271,984	1,446	70,753	23,300	1,012,911
1915	21,033	1,804,631	5,625	282,752	3,372	225,509	23,286	1,861,874
1916	29,932	3,768,139	5,659	515,919	8,880	670,475	26,711	3,613,583
1917	36,159	3,808,266	5,207	448,032	10,778	998,470	30,588	3,257,828
1918	32,883	3,863,752	6,719	533,622	3,098	338,620	36,504	4,058,754
1919	21,415	1,933,560	10,635	791,226	9,107	817,328	22,943	1,907,458
1920	13,392	1,066,807	14,169	971,510	1,553	129,993	26,008	1,908,324

QUICKSILVER-MINING INDUSTRY, BY STATES.

ALASKA.

Mining was continued in a small way at the Parks mine in the Kuskokwim region, but no production was recorded in 1920.

ARIZONA.

Arizona produced no quicksilver, so far as known , in 1920. Prospecting and development were continued, however, on the Hughes and Porterie groups of claims in the Phoenix Mountains, Maricopa County, on deposits described by Schrader.[2] On the Hughes group some drifting was done on the 100-foot level and on the Porterie group about 750 tons of ore is stated to have been piled for subsequent treatment. In the Sunflower district, in the Mazatzal Range,[3] a one-pipe Johnson-McKay retort was set up on the L and N group, but was not operated.

CALIFORNIA.

Quicksilver mining declined greatly in California in 1920, and at the end of the year only one of the larger mines, the New Almaden, was in operation. The New Idria, Oceanic, Carson (Klau), New Guadalupe, Oat Hill, Helen, and Cloverdale all ceased production before the year ended. On June 20 a fire destroyed the reduction works of the New Idria mine, and about 420 flasks of quicksilver in the condensers was lost. The plant was rebuilt and was operated at about one-half capacity in September and October. The mine was closed in November to await improvement in the quicksilver market.

The production of the State was 9,849 flasks in 1920, valued at $784,571. Of this total, 9,557 flasks was obtained from furnaces, 58 flasks from retorts, and 234 flasks by hand washing the material from the site of demolished reduction works at New Almaden. The output in 1919 was 15,205 flasks, valued at $1,372,859. There was, therefore, in 1920, a decrease of 5,356 flasks, or 35.2 per cent, as compared with 1919, and a decrease in the total value of $588,288, or

[2] Schrader, F. C., Quicksilver deposits of the Phoenix Mountains, Ariz.: U. S. Geol. Survey Bull. 690, pp. 95–110, 1918.

[3] Ransome, F. L., Quicksilver deposits of the Mazatzal Range, Ariz.: U. S. Geol. Survey Bull. 620, pp. 111–128, 1915.

42.8 per cent. California produced 73.5 per cent of the total quicksilver output of the country in 1920, as compared with 71 per cent in 1919.

In the following table, which gives the annual yield of quicksilver in California from 1910 to date, the quantities are recorded in the present standard for domestic flasks of 75 pounds:

Quicksilver produced in California, 1850–1920.

Year.	Flasks.	Price per flask.	Value.	Year.	Flasks.	Price per flask.	Value.
1850–1909	2,068,097	.....	$92,743,017	1916	21,045	$125.89	$2,649,355
1910	17,211	$46.51	800,484	1917	23,938	105.32	2,521,151
1911	18,860	46.01	867,749	1918	22,664	117.50	2,663,020
1912	20,524	42.05	863,034	1919	15,205	90.29	1,372,859
1913	15,591	40.23	627,228	1920	9,849	79.66	784,571
1914	11,303	49.05	554,414				
1915	14,283	85.80	1,225,481		2,258,570	.....	107,672,363

As usual, San Benito County, in which is the New Idria mine, leads. That mine, in spite of its greatly curtailed production, still ranked first in productivity in the United States in 1920. Santa Clara County, which contains the New Almaden, the largest, deepest, and in total output the most productive quicksilver mine in the United States, follows, with San Luis Obispo and Sonoma counties holding third and fourth places, respectively.

Only 11 operators reported production in California in 1920 as against 20 in 1919. At 9 localities the metal was obtained by furnace reduction. Of these 9 reduction plants, 7 had closed at the end of the year. At 2 localities only was ore treated in retorts, and operations at these places were on a small scale. Altogether 89,580 tons of ore was mined, and 87,960 tons was treated. Of the ore treated, 87,760 tons was sent through furnaces and probably about 200 tons was retorted. At New Almaden 234 flasks of quicksilver was recovered from an unrecorded quantity of washed material.

Quicksilver produced in California, 1920, by counties.

County.	Quantity (flasks).	Value.
Kings	411	$32,740
Lake	345	27,483
Napa	258	20,552
San Benito	3,809	303,425
San Luis Obispo	1,224	97,504
Santa Clara	2,893	230,456
Sonoma	851	67,791
Other counties	58	4,620
	9,849	784,571

The Cuddeback mine, 2 miles from Woodford, Kern County, probably produced a small quantity of quicksilver during the first half of 1920, but inquiries at the end of the year failed to elicit any response.

The Dawson mine, Kings County, was worked productively by the Patriquin Mining Co. up to September, when it was sold to C. C. Jones, who also produced some quicksilver.

The Helen mine, Lake County, was worked for the first 11 months of the year, and the usual small output was made from the near-by Wall Street mine. With the closing of the Helen mine this county, which contains a number of well-known quicksilver mines, practically ceases to be productive.

The closing of the Oat Hill mine, after a plucky attempt by Mr. Murray Innes to revive this famous old mine, removes Napa from the list of quicksilver-producing counties.

The only productive mine in San Benito County in 1920 was the New Idria. On June 20 a fire destroyed the reduction plant, which was immediately rebuilt, but after two months' operation was closed to await a more favorable market for quicksilver. On December 20, 1920, the property of the company was placed in the hands of a receiver.

At the Oceanic mine, San Luis Obispo County, one of the two 50-ton furnaces was operated until October 31, when the whole plant was closed, it being found impossible to produce quicksilver profitably from such low-grade ore (0.31 per cent) at prevailing prices. The Carson (formerly the Klau) mine was also closed, and there is at present no active quicksilver mine in the county.

No production was reported from Santa Barbara County, although some development work was done by the Los Prietos Quicksilver Mining Co. on its claims on Santa Ynez River, 10 miles from Santa Barbara.

At New Almaden, Santa Clara County, the El Senador mine, about 4 miles northwest of the famous old workings in Mine Hill, continued to be productive and at the end of the year was the only mine in California where ore in any significant quantity was being mined and treated. As elsewhere noted, a small yield of quicksilver was obtained by hand washing at the old hacienda. The New Guadalupe Mining Co. ceased operations on December 1, after making a small output.

The closing of the Cloverdale mine, operated by the Western Mercury Co. on November 15, leaves Sonoma County without any active quicksilver mine.

A little quicksilver was produced by lessees from the old dumps of the Altoona mine, near Castella, Trinity County.

IDAHO.

No production was reported from Idaho, although some development work was done in the Yellow Pine district,[4] in Valley County, on the Fern, Monumental, and Idaho groups. Mr. J. L. Niday, president of the Idaho Quicksilver Mining Co., reports that the companies owning the three groups mentioned are planning to consolidate as the United Mercury Mines Co.

NEVADA.

The very small output from Nevada in 1920 came from the Ruby group, in Lander County, and from the Nevada Quicksilver mine, near Ione, in Nye County. The Red Devils mine, in the Pilot

[4] Larsen, E. S., and Livingston, D. C., Geology of the Yellow Pine cinnabar-mining district, Idaho: U. S. Geol. Survey Bull. 715, pp. 73-83, 1920.

Mountains, Mineral County, is reported to have been sold by Messrs. Bugg & Drew to H. G. Torrance. In general, the statistical returns for Nevada are fragmentary, and it is possible that a few additional flasks were produced for which no record was obtained.

Quicksilver produced in Nevada, 1911–1920.

Year.	Quantity (flasks).	Price per flask.	Value.	Year.	Quantity (flasks).	Price per flask.	Value.
1911	70	$46.01	$3,221	1916	2,198	$125.89	$276,706
1912	2,550	42.05	107,228	1917	997	105.32	105,004
1913	1,645	40.23	66,178	1918	1,044	117.50	122,670
1914	2,089	49.05	102,465	1919	756	90.29	68,259
1915	2,327	85.80	199,657	1920	83	79.66	6,612

OREGON.

At the War Eagle mine, in Jackson County, some ore was retorted and a 25-ton Scott furnace completed. At the Little Jean and Force mines, near Gold Hill, in the same county, some development work was done. The total output of the State in 1920 was 24 flasks, valued at $1,912.

TEXAS.

There were three producing mines in Texas in 1920, all in the Terlingua district, in Brewster County. The ore treated amounted to 20,770 tons.

Quicksilver produced in Texas, 1911–1920.

Year.	Quantity (flasks).	Price per flask.	Value.	Year.	Quantity (flasks).	Price per flask.	Value.
1911	2,326	$46.01	$107,019	1916	6,306	$125.89	$793,862
1912	1,990	42.05	83,680	1917	10,791	105.32	1,136,508
1913	2,750	40.23	110,633	1918	8,451	117.50	992,992
1914	3,144	49.05	154,213	1919	5,019	90.29	453,166
1915	4,417	85.80	378,979	1920	3,436	79.66	273,712

The Chisos, the leading quicksilver mine in Brewster County and second only to New Idria in its recent annual production, was active throughout the year, but the output was less than in 1919.

At the Big Bend mine, at Study Butte, the 50-ton Scott furnace was completely overhauled and the old brick condensing chambers were replaced by upright tile condensers. In the mine the principal work of the year was exploratory, but some ore was produced in connection with development. On November first the low price of quicksilver forced the company to suspend operations.

The Texas-Almaden or Dallas mine made a small output from retorting old furnace soot. Work at the Mariposa and Mariscal mines was confined to prospecting.

NOTES ON FOREIGN QUICKSILVER DEPOSITS.

SPAIN.

An interesting feature of the Spanish production for 1919 is the return of the Almaden mine to its former scale of productivity. Evidently the change in management described in the report on quicksilver for 1919 has had beneficial results. The production of this mine in comparatively recent years of its long history is given in the following table, compiled from the Estadística minera de España. The figures of this table may be compared with those given for Spain as a whole on page 422.

Quicksilver produced at the Almaden mine, Spain, 1900–1919.

Year.	Metric tons.	Flasks of 75 pounds.	Year.	Metric tons.	Flasks of 75 pounds.
1900	1,022.84	30,066	1910	1,102.82	32,417
1901	687.76	20,217	1911	1,478.82	43,470
1902	1,375.24	40,425	1912	1,223.75	35,972
1903	910.77	26,772	1913	1,223.30	35,959
1904	1,070.05	31,454	1914	935.22	27,491
1905	791.56	23,268	1915	1,200.10	35,277
1906	1,500.84	44,117	1916	771.18	22,669
1907	1,160.88	34,124	1917	827.11	24,313
1908	1,017.00	29,895	1918	544.65	16,010
1909	1,344.01	39,507	1919	1,207.63	35,498

Two papers on the Almaden mine have recently appeared, one by Gould [5] and one by De Kalb.[6] Incidentally these accounts show that the oft-repeated references to the competition of quicksilver produced by the convict labor of Spain are wholly without foundation. The men are not only well paid in comparison with other Spanish workmen, but in many respects they are especially favored. They receive full monthly pay for eight days' work of four hours each. Moreover, the miners receive a bonus that varies with the quantity of ore raised. Wages have nearly trebled in the last 10 years.

AUSTRIA.

The loss of the Idria mine to Italy as a result of the World War has removed Austria from the list of quicksilver-producing countries. Beginning with 1919 the output from Idria is classed in the present report as Italian quicksilver.

HUNGARY.

The deposits near Zips, formerly in northern Hungary, are now in Czechoslovakia, and Hungary, so far as known, produces no quicksilver.

ITALY.

By the treaty of Rapallo, November 12, 1920, between the Italian and Jugoslav governments, the Idria quicksilver mine, formerly the property of the Austro-Hungarian crown, passed definitely into the possession of the Italian Government. The decree referred to in this

[5] Gould, H. W., The Almaden quicksilver mine in Spain: Min. and Sci. Press, Apr. 23, 1921, pp. 567–569.
[6] De Kalb, Courtenay, The Almaden quicksilver mine; with a note on the ore by F. L. Ransome: Econ. Geology, vol. 16, pp. 301–321, 1921.

report for 1918, proposing to make the mining and sale of quicksilver an Italian Government monopoly, was not followed by the legislation necessary to carry it into effect. Another plan under consideration by the Government was to turn the Idria mine over to a cooperative organization composed of the mine workers. This suggestion, an obvious concession to the socialists, naturally evoked adverse criticism from men familiar with mine management, and so far as known has not been put into operation.

The following note[7] on the Idria mine has recently appeared:

The Giornale di chimica industriale e applicata reports that the Italian Superior Mining Council have given their decision with regard to the future administration of the Idria quicksilver mines and the zinc mines at Raibl, in the Carniola, formerly owned by Austria. Efforts to obtain a lease of the Idria mines are stated to have been made by the Società Monte Amiata, which works the Abbadia San Salvatore mine, the largest quicksilver mine in Tuscany. A similar attempt was made by a cooperative society formed by the miners employed at the Idria undertaking. The workers employed at the Raibl zinc mines had also applied for the lease of that property to their society. The Italian Government decided to refer the question to the Mining Council, who have reported in favor of State administration of the mines mentioned, holding that the welfare of mining districts was a matter of national interest and that the proximity of the mines to the Italian frontier rendered it desirable, from a military standpoint, that Government control should be maintained.

An interesting account of the Idria mine, in Spanish, has recently appeared.[8] The mine is described as situated in a pleasant valley inclosed by pine-clad hills, near the confluence of the torrent Nikova with the Indrica, a tributary of the Isonzo. It is between 17 and 18 miles by wagon road from Unterloitsch, the nearest railway station. The mine workings extend under the town of Idria. It appears that the occurrence of quicksilver was first noticed by Virgilio Formentini, an Italian noble of Cividale, about 1470, when the ground was under the jurisdiction of the Venetian Republic. Mining began soon afterward and by the beginning of the sixteenth century the industry was so flourishing as to arouse the cupidity of Maximilian, the emperor of Austria, who in 1509 gained possession by force of arms. By the peace of Noyon, however, in 1516, Idria was restored to Venice. Mining prospered under the dominion of Venice up to about 1580, when the mine again fell into the hands of the Hapsburgs and remained Austrian Crown property up to the World War.

A brief account of the geology of the mine was given in the report on quicksilver for 1917,[9] and the part of Castelli's paper dealing with this subject need not be summarized here.

The mine has 13 levels, of which the lowest is at a depth of 1,100 feet (335 meters). There are four shafts in active use and two used for ventilation. There are 25 quicksilver furnaces having a total capacity of about 500 tons in 24 hours. Of the furnaces, 13 are for coarse ore, 6 (Cermak-Spirek) for intermediate ore, and 6 for fine ore. The mine is also equipped with a factory for the manufacture of vermilion. In all about 1,500 men are employed.

The following table of production is condensed from one presented by Castelli, the quantities given in metric tons being converted into

[7] Min. Jour. (London), Sept. 3, 1921, p. 656.

[8] Castelli, Gaetano, La mina de mercurio de Idria: Revista minera, metalúrgica y de ingeniería, Aug. 24, 1921, pp. 453–455. This article is a translation from the journal Rassegna mineraria, metalurgica e chimica, of Rome, recent numbers of which have not yet reached the library of the U. S. Geological Survey.

[9] U. S. Geol. Survey Mineral Resources, 1917, pt. 1, pp. 395–396, 1921.

short tons and standard flasks. The source of the figures is not stated, but presumably they are taken from the mine records, and up to the year 1913, the latest for which Austrian Government statistics are available, they check within a few flasks of the official figures for Austria as a whole. Columns in the original table giving the prices and value of the output have been omitted, and a column giving the metallic equivalent of the vermilion has been added.

Quicksilver and vermilion produced at Idria, 1900–1918.

Year.	Ore treated (short tons).	Quicksilver produced (flasks).	Won tenor (per cent).	Vermilion produced (pounds).	Vermilion equivalent in metallic quicksilver (flasks).
1900	94,972	14,639	0.64	102,515	1,178
1901	100,585	15,056	.61	102,956	1,183
1902	97,211	14,892	.64	97,885	1,125
1903	91,845	15,382	.67	53,131	610
1904	97,310	15,765	.64	77,603	892
1905	94,760	15,262	.66	84,657	973
1906	100,435	15,465	.64	74,075	851
1907	98,349	15,488	.65	106,924	1,228
1908	99,366	16,802	.69	102,074	1,173
1909	101,777	17,187	.69	109,790	1,261
1910	111,222	17,716	.69	103,176	1,185
1911	122,374	20,697	.70	154,103	1,771
1912	129,830	22,414	.72	158,512	1,821
1913	143,971	24,103	.72	138,450	1,591
1914	154,435	25,873	.71	31,747	365
1915	120,757	22,340	.75	25,574	294
1916	72,858	12,063	.84	13,659	157
1917	102,488	19,066	.84	7,937	91
1918	82,604	12,346	.71	20,944	241

So far as known, Idria is the only mine from which any considerable part of the output is in the form of vermilion. This pigment is made by subliming a mixture of quicksilver and sulphur, so that the quicksilver used is probably figured in the production in the third column of the table. This, however, is not definitely stated.

The production of quicksilver from Venezia Giulia in 1919, probably all from the Idria mine, is officially given as 297 metric tons,[10] or 8,730 flasks.

The Italian output in 1920 was considerably reduced by a strike of the workmen in the Monte Amiata district.

CZECHOSLOVAKIA.

It is reported[11] that the Primplex Co. of Prague is about to open a quicksilver mine at Goellnitz which has been idle for more than 20 years.

ALGERIA.

Algeria exported in 1920 only 200 kilos, or about 6 flasks, of quicksilver, as against 8,100 kilos, or 238 flasks, in 1919.

MEXICO.

The production of quicksilver in Mexico declined from 3,496 flasks in 1919 to 2,270 flasks in 1920. Most of this was exported to the United States by way of Laredo and New York.

[10] Riv. servizio minerario nel 1919, advance summary.
[11] Min. Jour. (London), Apr. 3, 1921, p. 327.

NEW ZEALAND.

The following note concerning the quicksilver deposit at Puhipuhi 95 miles north of Auckland, now being operated by the New Zealand, Quicksilver Mines (Ltd.), has recently appeared:[12]

The company's property, consisting of 433 acres, was first worked by a small company under the name of the Whangarei Cinnabar Co., and was afterward re-formed into the New Zealand Quicksilver Mines (Ltd.). The capital of the company is £15,000 in 60,000 shares of 5/— each, of which roughly 25,000 are fully paid up, 25,000 paid up to 3/—, and 10,000 reserved.

The basement rocks are andesitic in character, and are overlain by limestones, quartzites, shales, and chert capped by doleritic or basaltic flows. Within the ore shoot the cinnabar is disseminated through the fractured chert for an unknown distance from the hanging wall, which is composed of a band of 12 inches of hard oxidized iron minerals. The richest ore is adjacent to the hanging wall, and contains a fairly uniform figure of 10 per cent Hg, which is mixed with ferric iron from the hanging wall. There is no footwall. A stoping width of 78 inches, averaging at least 2 per cent Hg, is maintained.

The present company purchased the Novak shaft furnace formerly at the Ascot Mine, Karangahake, and has been treating ore won from the mine. This, up to the present, has produced 395 flasks of 75 pounds each, a total of 29,625 pounds weight, or over 11 tons of mercury, which has been sold for £8,000.

RECENT PUBLICATIONS ON QUICKSILVER.

Compiled by Isabel P. Evans.

Boletín Minero, Departamento de Estadística, Promedio de los metales que en seguida se expresan, en el mes de septiembre y en el mes de octubre de 1920 (mercurio): Vol. 10, p. 668, Mexico City, 1920. The values are given according to the New York market prices.

Boletín Minero, Departamento de Minas, Cuadro que manifiesta la producción y exportación de minerales y metales en la Republica Mexicana durante los años 1910 á 1919 (mercurio): Vol. 10, p. 288, Mexico City, 1920. Production of mercury is given in the table, not its exportation. The greatest production was in 1910; the least in 1917.

Bouton, C. M., and Duschak, L. H., The determination of mercury: U. S. Bur. Mines Tech. Paper 227, 44 pp., 2 pls., 1 fig., 1920. Describes and illustrates the analytical procedure of the determination of mercury in quicksilver ores containing less than 1 per cent of mercury.

Bradley, W. W., California mineral production for 1919, with county maps (quicksilver): California State Min. Bur. Bull. 88, pp. 34, 56–61, 1920. After stating production and prices in California discusses the present economic situation and indorses tariff protection.

Burcham, W. D., Quicksilver: Mineral Industry, vol. 28, pp. 614–621, 1920. The production of quicksilver in 1919, the writer predicts, will be found to be the smallest since 1860, except that in 1914.

Butler, B. S., Loughlin, G. F., Heikes, V. C., and others, The ore deposits of Utah (cinnabar, quicksilver): U. S. Geol. Survey Prof. Paper 111, pp. 106, 107, 144, 177, 395, 542, 543, 551–552, 566, 1920. Localities in which quicksilver occurs are Gold Spring, Mercur, Marysvale, Mount Baldy, and Sheep Rock districts. The deposits are small and unimportant.

Castello, W. O., The commercial minerals of California (quicksilver or mercury): California State Min. Bur. Bull. 87, pp. 81–82, 1920. The greatest consumption of mercury is in manufacture of fulminating caps and in drugs. Gives its properties and ores, geographic distribution, and the most satisfactory method for testing. Briefly describes the process of metallurgy.

China Year Book, 1919–20, Minerals, mines, and mining (quicksilver), p. 78, 1920. Gives the localities in China in which cinnabar (sulphide of mercury) occurs. The largest cinnabar mines are at Tuanshankiang, 15 miles from Lungchikow, in Kweichow Province. Samples of this ore assayed by an expert give a maximum of 4.4 per cent of mercury and a minimum of 1.7 per cent. The bulk of the 456,300 pounds of mercury produced in 1915 came from Kweichow.

[12] Chem. Eng. and Min. Review, Mar. 5, 1921, vol. 13, p. 205.

De Iongh, W. H. D., Enkele geologische en mineralogische mededeelingen over Mexico in het algemeen en over de mijndistricten Zacatecas, Pachuca en Real del Monte, in het bijzonder (kwikzilver): De Ingenieur, 35e Jaarg., pp. 4–9, 2 text figs., 1920. States that almost half the quicksilver is lost in the process of getting it through the Pachuca tanks.

Dolmage, Victor, Barkley Sound, Vancouver Island, B. C. (mercury): Canada Geol. Survey Summary Rept., 1919, pt. B, pp. 15b, 16b, 18b, 1920. The mercury deposit is situated on a small creek which enters Sechart Channel one-fourth mile east of Sechart whaling station and is one-half mile from the beach. It is one of only two occurrences of mercury known in British Columbia west of the Kamloops deposits. The deposit is small and of doubtful value.

Engineering and Mining Journal, A quicksilver melodrama: Vol. 109, pp. 56–57, Jan. 10, 1920. Editorial comment and brief account of the attempt to corner the American quicksilver market early in 1916.

Fansett, G. R., Field tests for the common metals (mercury-quicksilver): Arizona Univ. Bull. 105 (Min. Tech. Ser. No. 23), p. 17, 1920. Gives two simple tests for the detection of mercury.

Gardner, C. W., An interesting experiment: Min. and Sci. Press, vol. 120, p. 929, June 26, 1920. Behavior of mercury into which a gold bar is dipped.

Gustin, Wellington, Frenzied finance in quicksilver: Eng. and Min. Jour., vol. 109, pp. 75–78, Jan. 10, 1920. History of the case of McNear (Inc.) vs. American & British Manufacturing Co. in an alleged breach of contract in regard to quicksilver in 1916. The supreme court of Rhode Island refused to sustain contracts made with a view of controlling production and sale of quicksilver during the war.

Harkins, W. D., and Ewing, W. W., The surface energy of mercury and the energy relations at the interface between mercury and other liquids: Am. Chem. Soc. Jour., vol. 42, pp. 2539–2547, 1920. Treats of the surface energy relations of mercury in a vacuum, the apparatus and experimental procedure, methods of purification of mercury, the adsorption of vapors on a mercury surface, the accuracy of the experimental work, and discusses the results.

Harkins, W. D., and Grafton, E. H., Surface tension and molecular attraction; on the adhesional work between mercury and organic liquids: Am. Chem. Soc. Jour., vol. 42, pp. 2534–2538, 1920. Gives tables of the surface tension of mercury in air, in water, in different liquids, and its interfacial tension and adhesional work in different organic liquids at 20° C.

Innes, Murray, The declining quicksilver production: Eng. and Min. Jour., vol. 110, p. 768, 1920. "Two-thirds of the mines that were producing in the first quarter are no longer operating. The extensive works of the New Idria mine were destroyed by fire in June and the California output has declined to 300 flasks monthly."

Larsen, E. S., and Livingston, D. C., Geology of the Yellow Pine cinnabar-mining district, Idaho: U. S. Geol. Survey Bull. 715, pp. 73–83, 1920. No definite prediction as to future possibilities can be made, because the district has not been sufficiently prospected. No large ore body has yet been found.

Lindgren, Waldemar, Mineral deposits (quicksilver), 2d ed., pp. 487–501, 5 figs., 1919. Reviews the distribution, genesis, geologic features, structure, and general occurrence of quicksilver deposits and the production and uses of quicksilver.

Mining and Scientific Press, Italian quicksilver industry: Vol. 120, p. 424, March 20, 1920. The ore-producing zone in the Monte Amiata district stretches for 40 kilometers parallel to the Apennines and covers an area of 400 square kilometers. Gives the production of mercury (in tons) in the Monte Amiata (Grosseto-Siena) districts for 1915–1918.

Overbeck, R. M., Placer mining in the Tolovana district [Alaska] (cinnabar): U. S. Geol. Survey Bull. 712, p. 183, 1920. A little cinnabar is found in concentrates from Ruth and Lillian creeks and near the head of Livengood Valley. "Cinnabar is particularly abundant on Olive Creek and is derived from a weathered granite near the head of the creek."

Physicist, An interesting experiment: Min. and Sci. Press, vol. 121, p. 226, Aug. 14, 1920. Asks if the observations in C. W. Gardner's experiment are accurately recorded. Laws of siphoning should hold.

Place, R. G., Assaying quicksilver ores: Eng. and Min. Jour., vol. 109, p. 1313, 2 figs., June 12, 1920. Details of three methods for assaying quicksilver ores, now used at the New Idria Quicksilver Co.'s mines at Idria, Calif.

Ransome, F. L., Mercury, in J. E. Spurr's "Political and commercial geology and the world's mineral resources," pp. 337–348, 1920. Treats of probable areas for new deposits, the modifications likely to be caused by changes in mining methods, the political and commercial control of the quicksilver industry, and the uses and geographical distribution of mercury.

Read, T. T., An interesting experiment: Min. and Sci. Press, vol. 121, pp. 115–116, July 24, 1920. Comment on the experiment of Charles W. Gardner. Quicksilver wets gold as oil wets a lamp wick. States that the solubility of gold in mercury is very low.

Schwerin, Martin [An interesting experiment]: Min. and Sci. Press, vol. 121, p. 116, July 24, 1920. Offers an explanation of the experiment described by Charles W. Gardner. "The forces acting were gravity, amalgamation, resistance of the gold to passage of mercury, and the surface tension of mercury."

Singewald, J. T., The Huancavelica mercury deposits, Peru: Eng. and Min. Jour., vol. 110, pp. 518–522, geol. map, Sept. 11, 1920. Gives the geology of an old South American mining district located at a great altitude in sedimentary formations of the Andes and difficult of access. Attempts are now being made to exploit the mercury with modern mining methods.

Spurr, J. E., Who owns the earth? (quicksilver): Eng. and Min. Jour., vol. 109, p. 387, Feb. 7, 1920. Comparison in tabular form of mercury in the United States, British Empire, Italy, Germany, and Austria-Hungary.

Stowell, E. G., and Coghill, W. H., Experimental flotation of low-grade quicksilver ore: Min. and Sci. Press, vol. 120, pp. 117–121, Jan. 24, 1920. Cinnabar ore containing 15 per cent of mercury subjected to fine grinding and the pulp treated with lime water. A 90 per cent extraction obtained by flotation methods.

Troegel, D. H., Die Quecksilberproduction in Europa: Metall u. Erz, Jahrg. 16, Heft 11, pp. 243–247, Halle a S., 1919. Gives methods of mining and milling and costs of production.

Troegel, H., and Ahlfeld, F., Zie Zinnobervorkommen in der südlichen Toskana: Zeitschr. prakt. Geologie, Jahrg. 28, Heft 2, pp. 21–28; Heft 3, pp. 37–46, 1920. Gives a geologic sketch of the Monte Amiata region, describes each locality in which the cinnabar occurs, and discusses the origin of the deposits.

Wittich, Ernesto, Criaderos de cinabrio en las tobas basálticas del Cerro El Gigante, Guanajuato: Petróleo, vol. 13, pp. 7, 10, Apr. 24, 1920. Describes an occurrence of cinnabar in the State of Guanajuato, in the basaltic tufas on the southeast side of the hill El Gigante. This deposit was first noticed in 1811 by Humboldt and afterwards in 1838 by H. Galeotti (Roy. Acad. Belgium Bull., vol. 5, p. 4).

Wittich, Ernesto, Observaciones acerca de placeres de cinabrio y oro, encontrados en el distrito de Guadalcazar, San Luis Potosí: Bol. minero, vol. 10, Nos. 3–4, pp. 253–256, 1920. The cinnabar was deposited in a deep valley which constitutes an orographic depression about 8 by 2 to 2.5 kilometers. In a former epoch this was occupied by an extensive lagoon, which is now reduced to a small pool and temporarily dried up.

GOLD, SILVER, COPPER, AND LEAD IN ALASKA.[1]

(MINES REPORT.)

By Alfred H. Brooks.

PRODUCTION.

The following table gives an estimate of the total production of gold, silver, copper, and lead in Alaska to the end of 1920:

Gold, silver, copper, and lead produced in Alaska, 1880–1920.

Year.	Gold.		Silver.		Copper.		Lead.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Commercial value.	Quantity (pounds).	Value.	Quantity (short tons).	Value.
1880–1915..	12,619,051	$260,858,943	4,923,198	$2,821,911	219,913,375	$34,919,581	1,261	$109,604
1916.....	834,068	17,241,713	1,379,171	907,495	119,854,839	29,484,291	820	113,160
1917.....	709,049	14,657,353	1,239,150	1,021,060	88,793,400	24,240,598	852	146,584
1918.....	458,641	9,480,952	847,789	847,789	69,224,951	17,098,563	564	80,088
1919.....	455,984	9,426,032	629,708	705,273	47,220,771	8,783,063	687	72,822
1920.....	404,683	8,365,560	953,546	1,039,364	70,435,363	12,960,106	875	140,000

Though the mining industry of Alaska as a whole suffered a serious depression in 1920, yet the value of the total mineral output was greater than in 1919, chiefly because of the great increase in the production of copper, to be credited largely to the four leading copper mines in the Territory. The value of the total mineral product of Alaska was about $19,600,000 in 1919 and $23,400,000 in 1920. The output of the gold placers has decreased, but that of the gold lode mines has been maintained.

GOLD AND SILVER.

The subjoined table gives an estimate, based on the best available data, of the gold and silver produced in Alaska from different sources since mining began in 1880. About $65,900,000 worth of gold, or about one-fifth of the total estimated output, was produced before 1905, and there is but scant information as to its source. For the period since that time fairly complete statistical returns are available, and it is probable that the figures presented in the following

[1] The data on mining conditions and production here given are abstracted from a paper published in U. S. Geol. Survey Bulletin 722. The author was assisted in the statistical work by T. R. Burch. The original paper and the papers that accompany it treat the subject at greater length than is desired here and they should be consulted by those who require the more detailed information.

table are sufficiently accurate to be valuable. The figures given for the silver recovered from placer gold and from siliceous ores are probably less accurate than those for the gold. Copper mining did not begin in Alaska until 1901, and the figures for gold and silver derived from this industry, as now presented, are therefore a close approximation to the actual output.

Gold and silver produced in Alaska from different sources, 1880–1920.

	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
Siliceous ores [a]	4,662,942	$96,391,594	1,674,872	$1,321,588
Copper ores	84,799	1,752,967	6,497,919	4,956,834
Placers	10,733,735	221,885,992	1,799,771	1,064,470
	15,481,476	320,030,553	9,972,562	7,342,892

[a] Including small quantities of galena ore.

The above table shows that 30 per cent of all the gold produced in Alaska since 1880 has been obtained from siliceous ores. During the last decade there has been a gradual increase in the percentage of the annual output of gold from the auriferous lodes. In 1911 the proportion was 25 per cent; in 1915, 37 per cent; in 1919, 46.6 per cent; and in 1920, 53 per cent.

Gold and silver produced in Alaska, 1920, by sources.

	Ore.	Gold.		Silver.	
		Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
Siliceous ores	tons	3,413,736	216,414	$4,473,687	246,292	$268,458
Copper ores	do	765,025	913	18,873	682,033	743,416
Placers	cubic yards of gravel	3,439,974	187,356	3,873,000	25,221	27,490
			404,683	8,365,560	953,546	1,039,364

LODE MINING.

Seventeen gold-lode mines and five prospects were operated in 1920 and produced gold worth $4,473,687. Twenty-three gold-lode mines and two prospects were operated in 1919 and produced gold worth $4,392,237. This increase came entirely from the gold mines of southeastern Alaska, as the output from all the other districts declined. It is not likely that the output from the low-grade mines of the Juneau district will be maintained, and hence the output of lode gold in Alaska will be less in 1921 than it was in 1920.

Gold and silver produced from gold-lode mines in Alaska, 1920, by districts.

District.	Mines operated.	Ore mined (short tons).	Gold.		Silver.		Average value per ton of ore in gold and silver.
			Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.	
Southeastern Alaska	8	3,409,197	210,536	$4,352,165	114,621	$124,936	$1.31
Willow Creek	3	2,850	3,067	63,400	146	158	22.30
Fairbanks district	[a] 2	504	967	20,000	164	178	40.03
Other districts	[b] 4	1,185	1,844	38,122	131,361	143,186	155.63
	17	3,413,736	216,414	4,473,687	246,292	268,458	1.39

[a] In addition a small quantity of ore was produced from 5 prospects.
[b] Includes 1 small mine in Kantishna district, 1 in McKinley district, and 2 in Kenai Peninsula.

PLACER MINING.

During 41 years of mining Alaska has produced gold to the value of $320,000,000, and $221,885,000 of this amount is to be credited to her placer mines. Less placer mining was done in 1920 than in 1919, and the profits on actual operations were also less. Except the installation of some dredges no new large placer-mining projects are definitely under way. Investigations of large bodies of gold-bearing gravel are, however, being made in several districts, and if these result in mining operations a revival of the industry is assured. Meanwhile any lowering of operating costs by cheaper freight rates and cheaper supplies will quicken the mining activities of the smaller operators. It can not be too strongly emphasized that the enormous alluvial gold reserves of Alaska[2] give every assurance of the eventual revival of placer mining.

There was a decrease of about 22 per cent in the value of the output of placer gold in 1920, as compared with 1919. The chief loss was in the Yukon camps, where the decrease was 31 per cent. Measured by production, the districts on Seward Peninsula were the most prosperous. The record of 488 placer mines operated in the summer of 1920 and 82 in the previous winter somewhat exaggerates the activity of the industry. These totals, like those given in all previous reports, include every placer-mine operation of the year, no matter how small, and among them are many whose output for the year amounted to only a few hundred dollars. About 150 mines were operated in the summer of 1920 and 20 mines in the previous winter that produced less than $1,200 worth of gold per mine. The total value of the gold produced by these mines was $95,000, and they employed about 230 men.

[2] Brooks, A. H., The future of Alaska mining: U. S. Geol. Survey Bull. 714, pp. 7–11, 1921.

Gold and silver produced from placer mines in Alaska, 1920, by regions.

Region.	Gold.		Silver.		Gravel mined (cubic yards).	Recovery per cubic yard.
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.		
Southeastern and southwestern Alaska	483.75	$10,000	83.27	$91	2,750	$3.64
Copper River region	9,674.99	200,000	1,014.78	1,105	160,000	1.25
Cook Inlet and Susitna region	2,660.62	55,000	397.02	432	78,000	.70
Yukon basin	96,508.08	1,995,000	12,905.46	14,068	1,272,924	1.57
Kuskokwim region	14,754.36	305,000	3,962.98	4,320	131,900	2.31
Seward Peninsula	62,887.49	1,300,000	6,813.06	7,426	1,792,100	.73
Kobuk region	387.00	8,000	44.47	48	2,300	3.47
	187,356.29	3,873,000	25,221.04	27,490	3,439,974	1.13

The following table is based in part on returns made by operators of placer mines and in part on known facts or assumptions concerning the richness of the gravels in the several districts. Although the table is thus in part an estimate it is probably nearly correct.

Gravel sluiced in Alaskan placer mines and value of gold recovered, 1915–1920.

Year.	Total quantity of gravel (cubic yards).	Value of gold recovered per cubic yard.	Year.	Total quantity of gravel (cubic yards).	Value of gold recovered per cubic yard.
1915	8,100,000	$1.29	1918	4,931,000	$1.20
1916	7,100,000	1.57	1919	4,548,000	1.10
1917	7,000,000	1.40	1920	3,440,000	1.13

Relation of recovery of placer gold per cubic yard to proportion produced by dredges.

	Percentage of placer gold produced by dredges.	Recovery per cubic yard.		
		Dredges.	Mines.	All placers.
1915	22	$0.51	$2.33	$1.29
1916	24	.69	2.64	1.57
1917	26	.68	2.21	1.40
1918	24	.57	1.84	1.20
1919	27	.77	1.31	1.10
1920	29	.69	1.53	1.13

The 22 dredges operated in 1920 employed crews numbering 145 men. Two of these dredges were in the Fairbanks district, 2 in the Iditarod, 1 in the Mount McKinley (McGrath) district, and 17 in Seward Peninsula. The average gold recovery of the 5 Yukon and Kuskokwim dredges was 94 cents per cubic yard, and that of the Seward Peninsula dredges was 48 cents per cubic yard. The inland dredges were operated for an average of 170 days, and the longest season was that in the Iditarod, which ran for 196 days. The Seward Peninsula dredges were operated for an average of 66 days, and the longest season for any one dredge was 96 days.

Gold produced by dredge mining in Alaska, 1916–1920.

Year.	Number of dredges operated.	Value of gold output.	Gravel handled (cubic yards).	Value of gold recovered per cubic yard.
1916	31	$2,679,000	3,900,000	$0.69
1917	36	2,500,000	3,700,000	.68
1918	28	1,425,000	2,490,000	.57
1919	28	1,360,000	1,760,000	.77
1920	22	1,129,932	1,633,861	.69

COPPER.

The increase in output of copper, shown below, is to be credited almost entirely to three mines of the Kennecott group, in the Chitina basin, and the Beatson mine, on Prince William Sound. Eight copper mines were operated productively in 1920 as compared with 11 in 1919. Of the productive mines, two on Prince William Sound were under development and recovered only small quantities of ore incidentally. The total production of copper shown in the following table includes, in addition to that of the copper mines, some copper won from ores mined chiefly for other metal.

Output of Alaska copper mines in 1920, by districts.

District.	Mines operated.	Ore (short tons).	Copper.		Gold.		Silver.	
			Quantity (pounds).	Value.	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
Ketchikan[a]	2	16,088	670,155	$123,308	912.98	$18,873	5,313	$5,791
Chitina[b]	2	[c]295,473	55,997,660	10,303,569	.....	.....	557,553	607,733
Prince William Sound	4	454,534	13,767,548	2,533,229	.....	.....	119,167	129,892
	8	766,095	70,435,363	12,960,106	912.98	18,873	682,033	743,416

[a] Includes some shipments of copper from other parts of Alaska.
[b] Kennecott Copper Corporation Annual Report for 1920.
[c] Includes a small amount of placer copper.

The average copper content of the ore mined in 1920 was 4.6 per cent. The ores yielded an average of $0.025 in gold and $0.97 in silver to the ton. The average yield for 1919 was 4.8 per cent of copper, $0.129 in gold, and $1.11 in silver. The large reduction in the average gold content of the ores mined in 1920 as compared with those mined in previous years was due to the closing of the Ellamar mine, whose ores carried much gold.

Of the total copper ore mined in Alaska in 1920, 96 per cent, or 732,549 tons, was treated by oil flotation and yielded 80,342 tons of concentrates, which averaged 32 per cent of copper. Most of the copper ore mined in 1920 was shipped to the Tacoma smelter, but a part of that mined in southeastern Alaska was treated at the Anyox smelter, in British Columbia.

In 1920, as in previous years, the Rush & Brown copper mine was the largest copper producer in southeastern Alaska. Copper was produced also at the Salt Chuck mine, better known for its production of palladium. Relatively little prospecting and no considerable development work was done on the copper deposits of southeastern Alaska. The three large mines, the Bonanza, Jumbo, and Mother Lode, were the only producing mines of the Chitina district in 1920, and no considerable developments were made at other mines. Some alluvial copper was produced incidentally to gold-placer mining in the Nizina district. On Prince William Sound the Beatson mine was the only property operated systematically throughout the year. The most notable advances were made at the Girdwood mine, where systematic underground and surface work was continued during much of the year. Small developments were continued at the Schlosser and McIntosh mines through a part of the year.

The above review shows that the Alaska copper-mining industry is in a rather discouraging situation in spite of the relatively large output of the metal in 1920. Except possibly in Prince William Sound, not much work was done during the year in opening new ore bodies. The falling copper market and certain local conditions have discouraged the launching of any new enterprises. Not only will the output of copper in 1921 be far less than that of 1920, but probably several years will pass before any new large copper-mining ventures will be under way.

LEAD.

The lead produced in Alaska in 1920 amounted to 875 tons, valued at $140,000, as compared with 687 tons, valued at $72,822, in 1919. In 1920, as in other years, most of the output of lead was a by-product derived from the gold ores of the Juneau district. The increase in 1920 over 1919 was derived largely from galena ore mined in the Kantishna district.

The recent development of rich silver-lead ores in the Mayo district [3] of the Yukon Territory, about 100 miles east of Dawson, has started a search for similar deposits on the Alaska side of the boundary, not because of the lead content of the ore but because of the recent high price of silver. Galena ores are rather widely distributed in Alaska, but no large deposits have been found. Though some work was done on a number of Alaska galena deposits in 1920, only one mine, in the Kantishna district, shipped any ore.

[3] Cockfield, W. E., The Mayo area, Yukon: Canada Geol. Survey Summary Rept., 1918, pp. 1B–22B, Ottawa, 1919.

LEAD AND ZINC PIGMENTS AND SALTS.

By C. E. Siebenthal and A. Stoll.

INTRODUCTION.

From 1884 to 1914, inclusive, the United States Geological Survey published an annual chapter in Mineral Resources under the title "Mineral paints," which discussed the output and trade conditions of natural mineral paints as well as of manufactured metal pigments. Since 1914 no chapter on natural mineral pigments has been published because of the lack of cooperation of some producers. The statistics of lead and zinc pigments, however, have been collected and published in the lead and zinc chapters, respectively. The growth in use and importance of these pigments and of several salts of these metals has made it evident that these industries would be best served by a separate chapter dealing with them. Investigations into the early production of these pigments in this country are not yet completed, but their results will be published in a later report.

PRODUCTION.

Lead and zinc pigments and salts are made both by smelting and by chemical processes. Sublimed lead, basic sulphate lead, and the various lead oxides are examples of lead pigments produced by sublimation in oxidizing furnaces; basic carbonate white lead and the lead salts are made by chemical processes. Sublimed lead is made directly from ore, but the lead oxides as well as white lead and lead salts are made from pig lead.

Zinc oxide and leaded zinc oxide are made after the American process directly from ore by sublimation in an oxidizing furnace, but some zinc oxide is made in this country by the French process, in which metallic zinc is sublimated in an oxidizing furnace. Lithopone and zinc salts are made by chemical processes, the zinc base being derived from zinc ore, metallic zinc, galvanizers' ashes, or scrap zinc. Lithopone is made by mixing equivalent portions of solutions of zinc sulphate and barium sulphide, which brings about a mutual precipitation of zinc sulphide and barium sulphate either in chemical combination or as a very intimate mixture.

Lead pigments and salts marketed in 1919 and 1920.

	1919			1920		
	Quantity (short tons).	Value.		Quantity (short tons).	Value.	
		Total.	Per ton.		Total.	Per ton.
Sublimed lead: [a]						
White	9,068	$1,049,107	$115.69	12,412	$2,083,647	$167.87
Blue	1,350	160,663	119.00	928	153,657	165.58
Red lead and orange mineral	32,362	5,314,255	164.21	34,431	7,523,089	218.50
Litharge	46,739	6,431,801	137.61	62,329	12,386,185	198.72
White lead:						
Dry	30,085	4,845,788	161.07	33,678	6,351,798	188.60
In oil	109,005	21,579,234	197.97	112,017	25,986,100	231.98
Lead arsenate	[b] 5,783	2,090,341	361.46	(b)	.....	.....
Lead acetate	[b] 2,092	552,435	264.07	(b)	.....	.....

[a] Includes basic sulphate lead.
[b] Statistics from Bureau of the Census. No statistics are available for 1920, but beginning with 1921 a census will be taken biennially by the Bureau of the Census.

Zinc pigments and salts marketed in 1919 and 1920. [a]

	1919			1920		
	Quantity (short tons).	Value.		Quantity (short tons).	Value.	
		Total.	Per ton.		Total.	Per ton.
Zinc oxide	117,639	$20,591,877	$175.04	99,444	$17,859,736	$179.60
Leaded zinc oxide	27,591	4,009,024	145.30	30,460	4,467,532	146.67
Lithopone	78,365	10,218,850	130.40	89,373	12,484,925	139.69
Zinc chloride, 50° Baumé [a]	59,228	4,185,351	70.67	68,945	4,421,718	64.13
Zinc sulphate [a]	2,763	194,436	70.37	3,072	221,582	72.13

[a] The statistics for zinc chloride and zinc sulphate represent actual production.

SOURCE.

The following table shows the source of the metal content of the lead and zinc pigments and salts manufactured in 1919 amd 1920.

Metal content of lead and zinc pigments and salts, 1919 and 1920, in short tons.

Source.	1919				1920			
	Lead.		Zinc.		Lead.		Zinc.	
	Pigments.[a]	Salts.	Pigments.	Salts.	Pigments.[a]	Salts.	Pigments.	Salts.
Domestic ore	11,179	.....	94,738	3,393	15,212	.....	106,257	6,284
Foreign ore	351	.....	2,079	.....	808	.....	4,438	.....
Metal	183,265	4,843	13,583	256	215,431	.....	16,786	110
Secondary material	.....	.....	10,702	10,018	.....	.....	12,870	9,479
	194,795	4,843	121,102	13,667	231,451	.....	140,351	15,873

[a] Includes lead in zinc oxide and leaded zinc oxide.

IMPORTS AND EXPORTS.

The following statistics of imports and exports of lead and zinc pigments and salts are taken from the publications or records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

IMPORTS.

The imports of lead and zinc pigments and salts, though considerable before the World War, dwindled nearly to the vanishing point during the war, but in the last two years they have nearly resumed their pre-war importance. The imports of zinc oxide and lithopone have come mainly from Belgium, with smaller quantities from Germany.

Basic carbonate white lead, red lead, litharge, and orange mineral imported and entered for consumption in the United States, 1916–1920.

Year.	Basic carbonate white lead.		Red lead.		Litharge.		Orange mineral.	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
1916	88,617	$8,050	20,467	$5,302	1,320	$150	70,934	$8,281
1917	20,238	1,965	50	13	.....	.....	33,294	4,892
1918	508	202	5	1	100	12	.....	.....
1919	21,213	2,490	7,199	1,136	.....	.....	39,781	5,082
1920	159,977	19,449	23,076	1,789	21,002	2,647	52,094	5,352

Zinc oxide, lithopone, zinc chloride, and zinc sulphate imported and entered for consumption in the United States, 1916–1920.

Year.	Zinc oxide.				Lithopone.[a]		Zinc chloride.		Zinc sulphate.	
	Dry.		In oil.							
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1916	447	$181,319	18	$4,076	2,372	$414,592	2	$453	(b)	$22
1917	119	52,649	5	876	229	35,718	2	403	(b)	57
1918	162	62,703	4	1,043	1	993	98	15,177	.....	.....
1919	105	44,338	3	1,351	744	127,121	1	192	(b)	152
1920	1,431	289,890	14	3,596	1,736	278,267	565	76,495	50	3,038

[a] This heading includes imports of lithopone and "zinc sulphide white." The imports for 1918 consisted of 2,670 pounds of "zinc sulphide white" and no lithopone; hence the high value.
[b] Less than 1 ton.

EXPORTS.

White lead and red lead exported from the United States, 1916–1920.

	White lead.		Red lead.[a]	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1916	13,718	$2,137,072	.....	.....
1917	9,869	2,089,659	[b]1,086	$267,238
1918	7,794	1,756,739	2,870	662,584
1919	14,017	3,037,292	3,114	735,177
1920	14,901	3,195,101	1,532	365,575

[a] Not separately classified prior to July 1, 1917. [b] July 1–Dec. 31, inclusive.

Zinc oxide exported from the United States, 1916–1920.

Year.	Quantity (short tons).	Value.
1916	13,942	$2,394,709
1917	15,446	3,148,898
1918	12,421	2,779,507
1919	14,703	3,059,276
1920	11,164	2,151,544

Zinc oxide exported from the United States in 1919 and 1920.

Destination.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Africa	11	$2,865	(a)	$165
Asia	684	151,921	400	80,288
Australia and Oceania	316	92,515	78	21,291
Philippine Islands	(265)	(79,185)	(31)	(8,047)
Canada	3,792	655,743	4,924	888,046
Cuba	96	24,880	127	35,592
Europe	7,560	1,556,371	4,168	741,024
France	(2,206)	(471,636)	(230)	(46,020)
Italy	(448)	(82,804)	(1,054)	(187,100)
Great Britain	(4,351)	(871,669)	(2,575)	(449,559)
Denmark	(325)	(75,587)	(63)	(13,019)
Mexico	190	49,300	230	58,544
South America	1,826	465,239	943	240,664
Brazil	(1,370)	(347,187)	(559)	(139,027)
Panama	152	38,996	224	65,899
Other countries	76	21,446	70	20,031
	[b]14,703	[b]3,059,276	[b]11,164	[b]2,151,544

[a] Less than 1 ton. [b] Figures in parentheses not duplicated in totals.

COPPER.

By H. A. C. Jenison.[1]

INTRODUCTION.

The production of metallic copper from the ore for industrial consumption requires at least three distinct operations—mining, smelting, and refining. Each of these operations embraces several processes, of which the preparation of the ore for smelting is ordinarily the most varied and complicated. The Lake Superior native-copper ores are the only important American source of copper in which the three operations are not necessary for the production of commercial copper. On account of these three operations it is possible to determine approximately the production of copper in the United States by the collection of mine statistics, smelter statistics, or refinery statistics. These three sets of statistics can never agree exactly, but each set has a peculiar advantage, and the coordination of all three accurately determines the essential features of the copper industry for the year.

The principal value of the mine statistics is that they determine most accurately the geographic distribution of production. They are also the only source of accurate data on the character of the ore, the copper and precious-metal contents of the ore, and the degree to which the ore is concentrated before smelting. They show the quantity of ore shipped from the mines, but are less accurate than the smelter figures in that they represent the estimated recoverable copper content and not the actual recovery. The smelter statistics show with fair accuracy the geographic distribution of the production and give accurately the quantity of crude copper actually recovered from the ores, including considerable copper from sulphur, lead, zinc, and siliceous ores that carry so little copper that the mines are not paid for it and frequently do not report it. The smelter figures also differ from the mine figures by the quantity of ore, matte, and other materials in stock at the beginning and at the end of the year. The refinery statistics indicate the quantity of copper made available for industrial consumption and the quantity of precious metals recovered from copper ore, but do not permit accurate distribution of production according to source, even the separation of production according to foreign and domestic sources being uncertain. The refinery figures differ from the smelter figures by the quantity of stocks of unrefined copper at the beginning and the end of each year.

The principal cause of the differences in the figures from the three different sources is the time factor involved in the successive stages of the production of refined copper. The interval from the time the ore is mined until the refined copper is available for commercial

[1] The statistical tables in this report were prepared by Miss Helena M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the United States Geological Survey.

use is about three months. Consequently, whereas the mine figures represent the quantity of copper actually mined each calendar year, the smelter and refinery figures represent the quantity of copper produced during that year from ore part of which was mined near the end of the preceding calendar year. The differences among the three sets of figures, however, should not be very great for any single year when the industry is normal.

As the smelter statistics permit accurate geographic distribution as to source and also represent the actual production of the copper, they are adopted in this report as showing the production of the country. They include the production of blister copper and the furnace-refined or Lake copper.

SUMMARY OF DOMESTIC AND WORLD STATISTICS.

Summary of statistics of the copper industry in the United States, 1913 and 1916–1920.

	1913	1916	1917
Production of copper:			
Smelter output.....pounds..	1,224,484,098	1,927,850,548	1,886,120,721
Mine production.....do....	1,235,569,727	2,005,875,312	1,895,434,349
Refinery production of new copper:			
Electrolytic.....do....	1,022,497,601	1,579,620,513	1,452,744,593
Lake.....do....	155,715,286	269,794,531	268,508,091
Casting and pig.....do....	58,611,026	39,337,155	152,293,487
Total domestic.....do....	1,236,823,913	1,888,752,199	1,873,546,171
Total domestic and foreign.....do....	1,615,067,782	2,259,387,315	2,428,546,171
Total new and old copper.....do....	1,888,000,000	2,959,000,000	3,195,000,000
Total ore produced.....short tons..	36,361,101	57,953,357	58,514,325
Copper ore produced.....do....	36,336,682	57,863,365	58,482,694
Average yield of copper.....per cent..	1.67	1.70	1.60
Average cost per pound of copper produced.....cents..	10.24	10.44	12.92
Average price per pound.....do....	15.5	24.6	27.3
Imports (unmanufactured).....pounds..	408,778,954	462,335,980	556,420,297
Exports of metallic copper [a].....do....	926,241,092	784,006,486	1,125,647,336
Withdrawn from total supply on domestic account:			
Total new copper.....do....	812,268,639	1,478,881,871	1,394,829,715
Total new and old copper.....do....	1,085,000,000	2,179,000,000	2,162,000,000
Stocks of refined copper [b].....do....	90,385,402	128,055,229	114,000,000
Stocks of blister and materials in solution [b].....do....	247,789,811	424,000,000	411,000,000
World's production.....do....	2,181,253,000	2,998,679,000	3,149,185,000
Value of production in the United States.....	$189,795,035	$474,288,000	$514,911,000

	1918	1919	1920
Production of copper:			
Smelter output.....pounds..	1,908,533,595	1,286,419,329	1,209,061,040
Mine production.....do....	1,910,022,841	1,212,334,041	1,224,550,151
Refinery production of new copper:			
Electrolytic.....do....	1,560,327,422	1,233,994,324	1,010,240,867
Lake.....do....	231,096,158	177,594,135	153,483,952
Casting and pig.....do....	91,450,611	21,897,336	18,698,421
Total domestic.....do....	1,882,874,191	1,433,485,795	1,182,423,240
Total domestic and foreign.....do....	2,432,385,290	1,805,306,801	1,634,908,644
Total new and old copper.....do....	3,138,000,000	2,380,000,000	2,260,000,000
Total ore produced.....short tons..	62,304,767	36,139,254	36,792,260
Copper ore produced.....do....	62,289,069	36,121,622	36,765,370
Average yield of copper.....per cent..	1.51	1.65	1.63
Average cost per pound of copper produced .....cents..	14.49	15.25	14.94
Average price per pound.....do....	24.7	18.6	18.4
Imports (unmanufactured).....pounds..	575,805,115	429,387,594	485,670,691
Exports of metallic copper [a].....do....	744,243,481	515,595,019	623,158,489
Withdrawn from total supply on domestic account:			
Total new copper.....do....	1,661,669,576	914,471,572	1,053,838,558
Total new and old copper.....do....	2,367,000,000	1,489,000,000	1,679,000,000
Stocks of refined copper [b].....do....	180,000,000	631,000,000	659,000,000
Stocks of blister and materials in solution [b].....do....	562,600,000	273,000,000	465,000,000
World's production.....do....	3,158,592,000	(c)	(c)
Value of production in the United States.....	$471,408,000	$239,274,000	$222,467,000

[a] Total exports of copper, exclusive of ore, concentrates, and composition metal.
[b] At the end of the year.
[c] Figures not yet available. See p. 455.

Copper produced in the United States from domestic ores, 1913, 1916–1920.

[Smelter output, in pounds fine.]

State.	1913	1916	1917	1918	1919	1920
Alaska	23,423,070	113,823,064	84,759,086	67,081,648	56,534,992	66,093,924
Arizona	404,278,809	691,847,307	719,035,514	769,521,729	536,515,368	552,988,731
California	32,492,265	43,400,876	44,933,846	44,150,761	23,548,698	11,822,028
Colorado	9,052,104	9,536,193	10,054,951	7,591,570	4,892,558	4,282,616
Georgia		803,699	930,691	397,078	8,306	3,663
Idaho	8,711,490	7,248,794	6,446,224	5,836,795	3,966,655	1,922,116
Maine			34,872	501,169	376,186	
Maryland		126,965	291,501			
Michigan	155,715,286	269,794,531	268,508,091	231,096,158	177,594,135	153,483,952
Missouri	576,204	377,575	407,141	232,073	588,570	533,368
Montana	285,724,467	352,139,768	276,225,977	326,426,761	176,289,873	177,743,747
Nevada	85,209,536	100,816,724	115,028,161	106,266,603	64,683,734	55,580,322
New Jersey		4,115				
New Mexico	50,196,881	79,863,439	107,593,615	96,559,580	60,377,320	52,159,751
North Carolina	180	5,961	125,004	79,200	3,334	
Oregon	77,812	2,433,567	1,105,097	2,630,499	2,808,017	2,529,311
Pennsylvania	245,337	904	115,000	34,500		618,361
South Carolina			210,000		2,297	
South Dakota					8,631	2,190
Tennessee	19,489,654	14,556,278	16,093,757	15,053,568	15,629,454	16,727,803
Texas	39,008	86,463	2,061,129	13,851	2,153	14,217
Utah	148,057,450	232,335,950	227,840,447	230,964,908	143,836,304	110,357,748
Vermont	5,771	324,400	102,522	896,630	582,561	
Virginia	46,961	1,066,143	146,912	1,248		
Washington	732,742	2,473,481	2,051,416	2,330,568	2,552,134	2,125,586
Wyoming	362,235	1,784,351	2,019,767	866,698	150,051	24,256
Undistributed	46,836				15,467,998	47,350
	1,224,484,098	1,927,850,548	1,886,120,721	1,908,533,595	1,286,419,329	1,209,061,040

Principal features of the copper industry in the United States, 1916-1920.

Year.	Refined copper, primary.	Secondary copper.	Smelter production, domestic ores.	Imports, in unmanufactured form.	Exports of metallic copper.	Withdrawn from total supply on domestic account (new copper).
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1916	2,259,400,000	700,000,000	1,928,000,000	462,000,000	784,000,000	1,479,000,000
1917	2,428,500,000	767,000,000	1,886,000,000	556,000,000	1,126,000,000	1,395,000,000
1918	2,432,400,000	705,000,000	1,908,500,000	576,000,000	744,000,000	1,662,000,000
1919	1,805,300,000	574,000,000	1,286,000,000	429,000,000	516,000,000	914,000,000
1920	1,634,900,000	625,000,000	1,209,000,000	486,000,000	623,000,000	1,054,000,000

Year.	Stocks of refined copper.[a]	Stocks of blister and materials in solution.[a]	Average cost per pound of copper produced.	Average yearly price per pound.	World's production.
	Pounds.	*Pounds.*	*Cents.*	*Cents.*	*Pounds.*
1916	128,055,229	424,000,000	10.44	24.6	2,998,679,000
1917	114,000,000	411,000,000	12.92	27.3	3,149,185,000
1918	180,000,000	562,600,000	14.49	24.7	3,158,592,000
1919	631,000,000	273,000,000	15.25	18.6	(b)
1920	659,000,000	465,000,000	14.94	18.4	(b)

[a] At the end of the year.

[b] Returns incomplete. See p. 455.

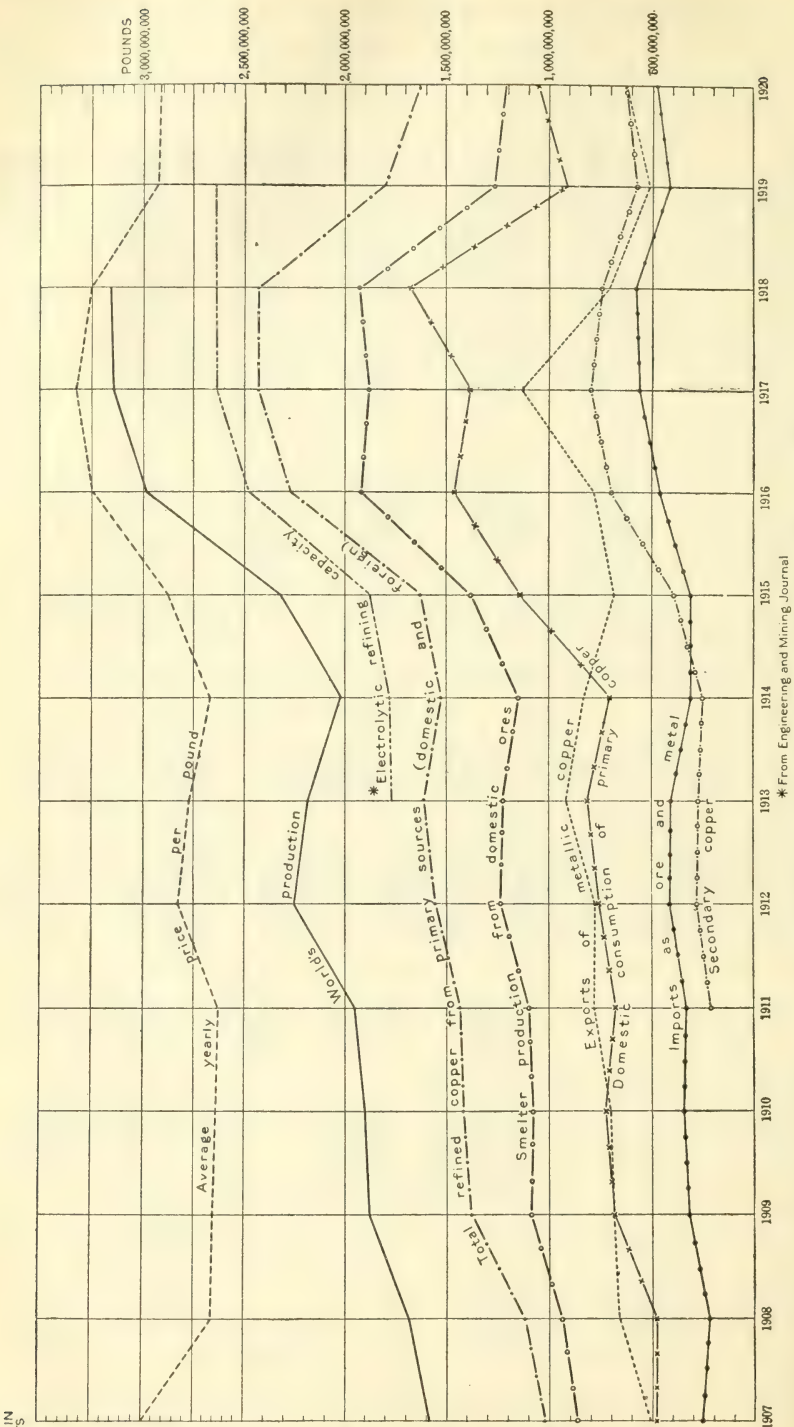


FIGURE 13.—Chart showing the principal features of the copper industry, 1907-1920.

World's production of copper (smelter output), 1915–1920, in metric tons.

[Where no footnotes are given, figures are taken from official publications. For countries from which ore or matte was exported for smelting, official figures have been converted to figures showing the quantity of copper recoverable by the smelters.]

Country.	1915	1916	1917	1918	1919	1920
Austria					648	1,645
England	239	282	190	182	146	(a)
France	966	1,374	1,003	1,228	(a)	(a)
Germany	b 35,000	b 35,000	b 45,000	b 40,000	(a)	(a)
Italy	940	1,867	1,331	1,139	1,374	(a)
Norway	2,828	1,614	1,810	2,856	b 440	(a)
Portugal	b 4,290	b 4,310	b 4,300	b 4,000	b 2,300	(a)
Russia	25,962	b 13,380	b 17,000	c 4,999	(a)	(a)
Spain	34,699	32,880	38,526	45,104	23,419	22,458
Sweden	4,561	3,181	4,423	2,956	3,558	1,289
Europe	109,485	93,888	113,583	102,464	(a)	(a)
Canada	45,716	53,139	49,545	53,873	34,044	37,014
Cuba	b 8,900	b 9,500	b 10,700	b 13,300	b 7,500	b 8,400
Mexico	20,598	28,411	50,986	70,223	56,172	46,057
United States	629,597	874,467	855,539	865,705	583,516	548,426
North America	704,811	965,517	966,770	1,003,101	681,232	639,897
Bolivia	7,500	8,000	10,000	8,000	(a)	(a)
Chile	52,341	71,288	102,527	b 115,000	b 65,800	b 95,000
Peru	34,728	43,078	45,176	44,414	39,230	32,982
Venezuela	c 597	c 1,175	c 2,958	c 2,079	c 188	(a)
South America	95,166	123,541	160,661	169,493	(a)	(a)
Belgian Kongo	b 14,280	b 22,500	b 27,900	b 20,238	23,028	18,962
Southern Rhodesia	3,191	3,194	3,548	2,952	2,732	2,820
Union of South Africa	10,993	10,549	8,101	4,824	3,577	1,075
Africa	28,464	36,243	39,549	28,014	29,337	22,857
Japan	75,416	100,636	108,038	90,341	78,443	d 62,930
Australia	43,941	40,367	39,860	39,315	19,307	e 26,604
Grand total	1,057,283	1,360,192	1,428,461	1,432,728	(a)	(a)

a Figures not yet available.
b Estimated by the U. S. Geological Survey.
c Figures from Imperial Mineral Resources Bureau.
d Figures from Econ. Review, April 29, 1921.
e Figures from Min. Jour. (London), May 9, 1921.

GENERAL CONDITION OF THE INDUSTRY.

The factors that worked to the disadvantage of the copper industry during 1919, notably the continued shortage and inefficiency of labor, the unsettled market, and the high cost of transportation and supplies, continued throughout 1920 with little change. The labor supply improved toward the end of the year, but this gain was offset by the collapse of the market in November and December.

During the first half of 1920 the domestic purchases and exports of copper were sufficient to give a bright outlook. Early in the summer, however, both domestic purchases and exports showed a decline due to the business depression throughout the world as well as to the low and fluctuating rate of exchange, and at the end of the year the stocks of copper were the largest in the history of the industry. The average price in 1920 was 18.4 cents, the lowest since 1915, and in December the average quoted price was less than the average cost of production. These conditions caused most of the large mines to close early in 1921, and it is likely that most of them will remain idle at least until the spring of 1922 before stocks and cost of produc-

tion are sufficiently reduced and the price sufficiently increased to permit profitable mining.

The other most salient feature of the year 1920 was the great amount of development work done by most of the large producers. Such work had been neglected during the war, and much of that done in 1920 was essential to put the mines on a proper productive basis. The results of the work were generally gratifying, and most companies reported that their mines were in better condition for large, economical production than they had been for several years.

It is generally supposed that the American copper industry is overdeveloped, that there will not for a long time be a domestic demand sufficient to keep the domestic mines operating at their full capacity, and that a greater foreign market for American copper is dependent upon the stabilization of exchange and the rehabilitation of industry in Europe. It is hoped, however, that during the next few years there will be an increase in domestic consumption sufficient to enable the majority of the producers to operate at nearly three-quarters capacity at a reasonable profit.

In considering the future of the American copper industry it is evident that cost of both production and transportation must be considerably reduced before the industry can take full advantage of industrial rehabilitation and expansion. The cost of labor, and consequently of supplies, may be reduced, and if it is, cheaper transportation may be expected.

COST OF PRODUCTION, 1909-1920.

The superpower survey made by the United States Geological Survey [2] required a general determination of the cost of production and the average selling price of copper over a period of years in order to calculate the probable cost of the proposed superpower system, and the following tables and discussion are abstracted from an analysis made by the writer for that purpose and published in the Engineering and Mining Journal.[3]

The mines were divided according to the three natural groups of deposits—Lake, vein and replacement, and disseminated (loosely known as "porphyries"). The total number of mines considered was 42, of which 11 were in the vein and replacement group, 11 in the disseminated group, and 20 in the Lake group. These mines represent so high and constant a percentage of the total smelter output of the United States that their average cost of production is doubtless fairly close to the average for all mines. Furthermore, the changes in the average cost by these mines have for some years been quickly reflected in the average price, and vice versa, indicating that these mines dominate the American copper industry.

The data upon which these tables have been calculated have been obtained from the annual reports to shareholders, except for companies which issue no reports, or which are engaged in so great a variety of metal production that the cost of copper can not be separated from the cost of other metals, or whose annual reports are made in terms that do not permit the determination of unit cost of production. These

[2] A superpower system for the region between Boston and Washington: U. S. Geol. Survey Prof. Paper 123, 1921.

[3] Costs of American copper production, 1909-1920: Eng. and Min. Jour., Mar. 18, 1922.

companies furnished confidentially their cost of production of copper, calculated on the same basis as that used in calculating the costs from data published in the annual reports. The average cost of production as herein determined consists of mining, milling, smelting, refining, transportation, and selling costs, charges for general administration and for depreciation of plant and equipment, and State and local taxes. The Federal income and excess-profits taxes and depletion charges are excluded. The value of precious metals recovered from the treatment of copper ores is credited to the cost of production and so is miscellaneous income incidental to mining operations, such as income derived from the smelting of small quantities of custom ore by a company that maintains a smelter for the primary purpose of smelting its own ore, or from the sale of small quantities of power by a company that maintains a power plant primarily for supplying power and light for its own operations.

During 1919 and 1920 many companies produced more copper than they sold, and to the cost of the unsold portion of the product was added the average marketing cost determined from the copper actually sold.

Copper produced in the United States by principal mines, 1909–1920, and average cost per pound.

Year.	Total smelter production.	Production by principal mines.							
		Vein mines.		Lake mines.		Disseminated-ore mines.		Total.	
		Quantity.	Average cost per pound.	Quantity.	Average cost per pound.	Quantity.	Average cost per pound.	Quantity.	Average cost per pound.
	Pounds.	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*
Pre-war:									
1909	1,092,951,624	272,830,408	8.97	226,575,286	9.9	154,089,208	9.2	653,494,902	9.34
1910	1,080,159,509	487,289,463	8.2	218,272,734	9.9	205,593,242	8.4	911,155,439	8.61
1911	1,097,232,749	463,322,929	8.8	213,093,306	9.6	263,284,521	8.1	939,700,756	8.78
1912	1,243,268,720	510,801,542	9.0	215,859,751	10.7	314,037,391	8.7	1,040,698,684	9.25
1913	1,224,484,098	492,092,409	10.1	130,487,378	13.8	389,239,696	9.3	1,011,819,483	10.24
1914	1,150,137,192	428,435,453	9.8	159,278,415	11.5	365,445,511	8.3	953,159,379	9.52
	6,888,233,892							5,510,028,643	9.30
War:									
1915	1,388,009,527	557,696,842	9.5	243,802,361	9.6	442,126,316	7.9	1,243,625,519	8.94
1916	1,927,850,548	787,443,989	10.7	259,511,319	12.4	665,469,103	9.3	1,712,424,411	10.44
1917	1,886,120,721	712,239,051	12.2	253,769,681	15.6	680,700,041	12.7	1,646,708,773	12.92
1918	1,908,533,595	723,478,901	13.6	226,901,556	18.9	724,069,192	13.98	1,674,449,649	14.49
	7,110,514,391							6,277,208,352	11.87
Post-war:									
1919	1,286,419,329	408,348,013	14.6	177,463,610	18.4	467,695,747	14.6	1,053,507,370	15.25
1920	1,209,061,040	450,760,285	14.2	153,021,787	18.2	470,250,341	14.6	1,074,032,413	14.94
	2,495,480,369							2,127,539,783	15.09
Grand total	16,494,228,652							13,914,776,778	11.35

Growth and operations of the principal disseminated-ore mines in the United States, 1909–1920.[a]

Year.	Ore in reserve.			Ore milled.			
	Quantity (short tons).	Average copper content (percent).	Total copper content (short tons).	Quantity (dry short tons).	Average copper content (percent).	Total copper content (short tons).	Recovery (percent).
1909	119,000,000	1.80	2,142,000.0	3,757,180	1.81	68,004.96	66.54
1910	243,860,823	1.6749	4,084,424.9	6,577,273	1.72	113,129.10	67.79
1911	492,870,487	1.76	8,674,520.6	9,145,598	1.69	154,560.61	68.53
1912	546,810,524	1.699	9,290,310.8	11,894,830	1.641	195,194.16	66.89
1913	560,289,576	1.67	9,356,835.9	16,025,309	1.55	248,392.29	66.45
1914	585,056,240	1.635	9,565,669.5	14,542,093	1.646	239,362.85	67.48
1915	691,035,064	1.6276	11,247,597.4	18,931,562	1.641	310,722.03	67.17
1916	768,956,864	1.571	12,080,356.8	28,501,741	1.587	452,386.36	68.74
1917	816,032,667	1.559	12,723,973.9	30,086,587	1.479	444,980.83	67.91
1918	814,140,979	1.537	12,514,224.2	32,425,668	1.436	465,696.17	68.91
1919	795,752,000	1.533	12,195,967.4	18,453,710	1.502	277,209.01	75.75
1920	790,818,949	1.477	11,676,999.7	20,278,611	1.392	282,321.97	76.33

Year.	Copper recovered by mills.		Net production of refined copper (pounds).	Cost per pound (cents).
	Total (pounds).	Per ton (pounds).		
1909	90,322,607	24.04	85,032,581	8.272
1910	153,184,688	23.29	147,274,817	7.63
1911	211,629,138	23.14	202,376,519	7.807
1912	261,091,519	21.95	249,712,570	8.615
1913	330,281,618	20.61	314,636,019	9.194
1914	323,212,362	22.23	309,234,720	8.164
1915	416,711,649	22.01	398,628,110	7.619
1916	618,760,669	21.71	599,861,127	8.631
1917	601,959,445	20.01	590,009,375	11.607
1918	636,613,359	19.63	628,265,818	12.105
1919	416,765,462	22.58	407,305,108	14.264
1920	427,610,499	21.09	416,434,944	13.984

[a] Statistics cover operations of two companies in 1909 and 1910; five companies in 1911, 1912, 1913, and 1914; six companies in 1915 and 1916; and seven companies from 1917 through 1920.

The difference between the average price and the average cost as given here does not represent actual profits. This difference would be considerably less if depletion charges, Federal income, and excess-profits taxes, and cost of deferred development work could be included in the calculation. The depletion charge, although it can not be considered an operating cost, must be deducted from operating income. The average depletion charge per pound of copper throughout the United States is not definitely known but probably ranges from about 2 to 4 cents and averages about 3 cents. The Federal income and excess-profits taxes have been very high for practically all these companies but can not be estimated. The cost of deferred development work that would normally have been charged to the war years will be paid from accumulated operating surplus and from future profits. The principal mines, furthermore, could not supply the total war demand, and the deficiency was made up by many small, high-cost mines. If the cost of production by these small mines could be taken into account it would appreciably increase the general average cost of production during the war period.

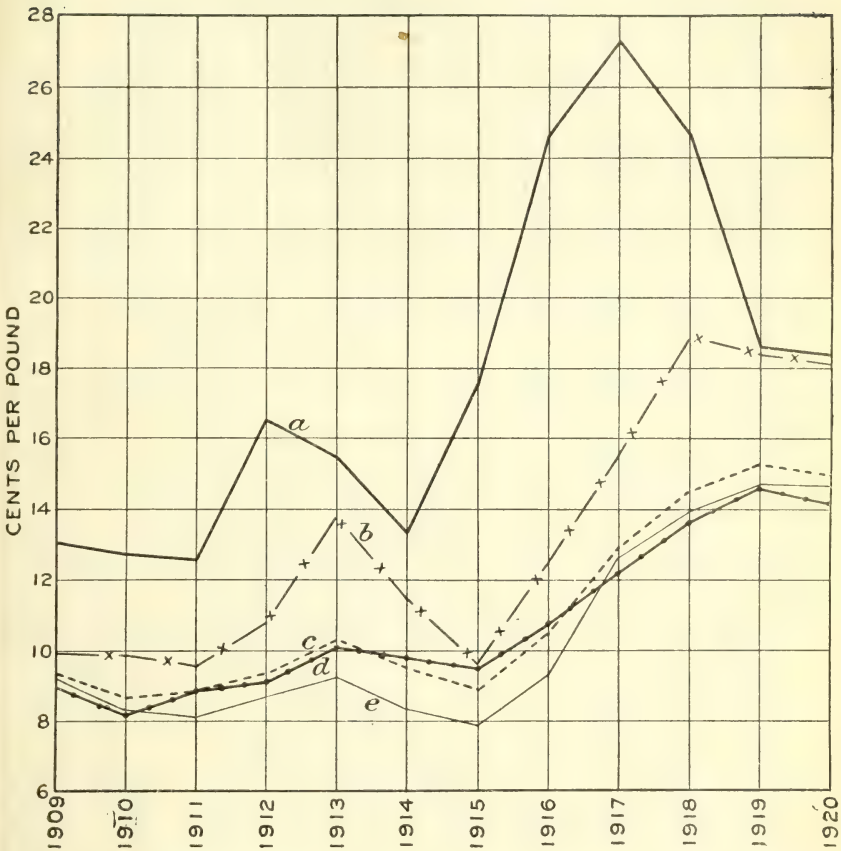


FIGURE 14.—Chart showing cost per pound of copper produced in the United States, 1909–1920. *a*, Average selling price per pound of copper; *b-e*, average cost per pound of copper produced (*b*, Lake group; *c*, all groups; *d*, vein and replacement group; *e*, disseminated (porphyry) group). Costs include mining, milling, smelting, refining, transportation, and selling costs; general administration and depreciation of plant and equipment charges; all taxes except Federal income and excess-profits taxes. Value of precious metals recovered and miscellaneous income incident to actual mining operations are credited to costs of production. Depletion of ore charges and Federal income and excess-profits taxes are the only items excluded.

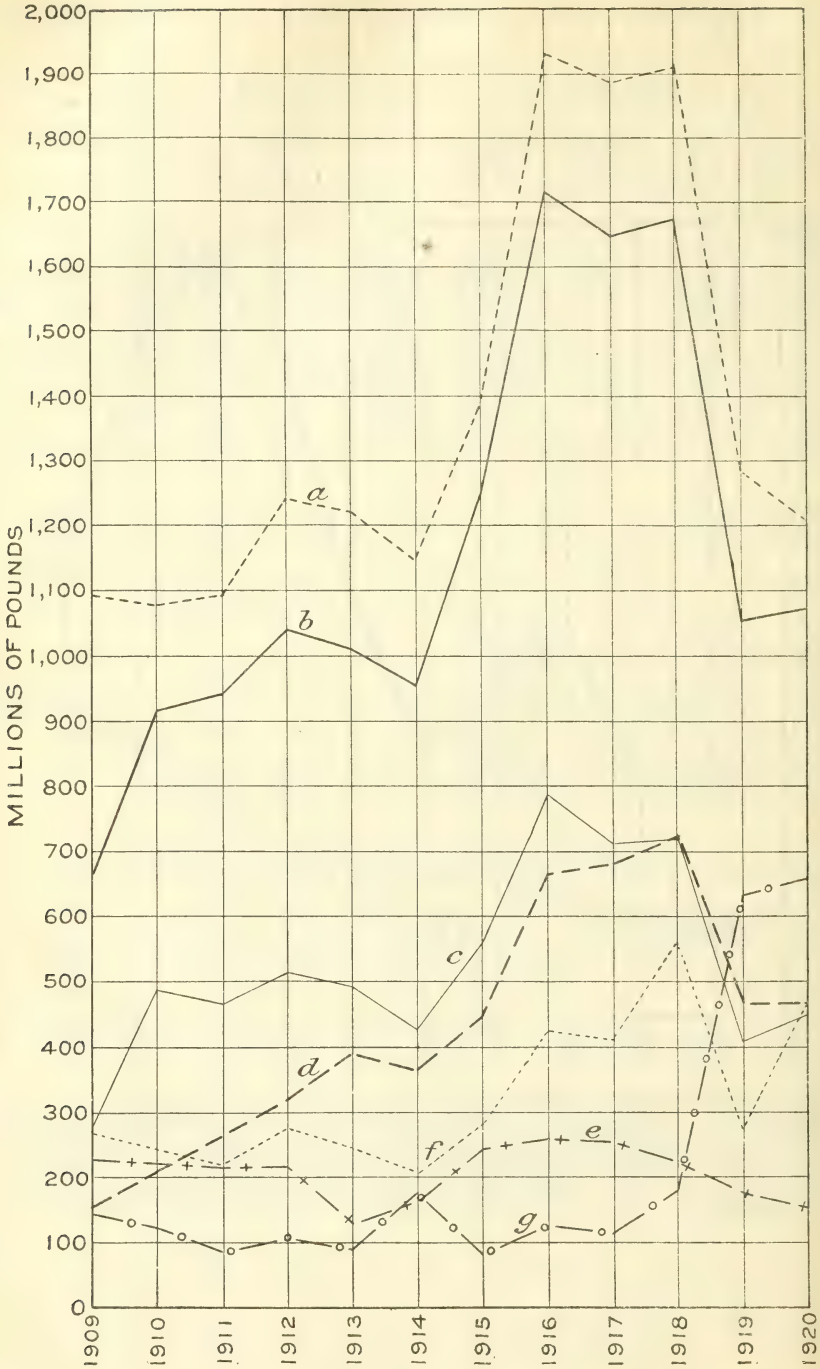


FIGURE 15.—Chart showing production of copper by the different groups of mines in the United States, 1909–1920. *a*, Total smelter production of copper in the United States from domestic ore; *b-e*, production of principal mines (*b*, all groups; *c*, vein and replacement groups; *d*, disseminated (porphyry) group; *e*, Lake group); *f*, stocks of blister and material in process of refining at end of each year; *g*, stocks of new refined copper in hands of refiners at end of each year.

PRODUCTION.

SMELTER PRODUCTION.

The smelter production from domestic ores in the United States in 1920 was 1,209,061,040 pounds of copper, valued at $222,467,000, making a total since 1845 of 29,602,069,472 pounds of copper, valued at $5,096,062,000. The production in 1920 represented a decrease from 1919 of 77,358,289 pounds.

The figures of smelter production in 1920 are based on returns made confidentially to the United States Geological Survey by all known smelting companies handling copper-bearing materials from the United States. To all companies and officials who have aided in furnishing this information and have given valuable time to answering inquiries concerning distribution of the output sincere thanks are extended. The following list gives the name of the owning or operating companies, the location, and the final copper product of smelting and refining plants treating material from the United States during 1920. It does not include lead and zinc plants that recovered copper as a by-product from mixed ores. Lists of lead and zinc smelters can be found in the reports on those metals.

Copper reduction plants that treated materials from the United States in 1920.

Location.	Company.	Final copper product.
Arizona:		
Ajo	New Cornelia Copper Co	Electrolytic.
Clarkdale	United Verde Copper Co	Blister.
Do	United Verde Extension Mining Co	Do.
Clifton	Arizona Copper Co. (Ltd.)	Do.
Douglas	Calumet & Arizona Mining Co	Do.
Do	Phelps Dodge Corporation	Do.
Globe	Old Dominion Co	Do.
Hayden	American Smelting & Refining Co	Do.
Humboldt	Consolidated Arizona Smelting Co	Do.
Miami	International Smelting Co	Do.
Colorado: Salida	Ohio & Colorado Smelting & Refining Co	Matte.
Maryland: Baltimore	Baltimore Copper Smelting & Rolling Co	Electrolytic.
Michigan:		
Hancock	Lake Superior Smelting Co	Anodes and lake.
Do	Quincy Mining Co	Do.
Houghton	Michigan Smelting Co	Do.
Hubbell	Calumet & Hecla Mining Co	Do.
Montana:		
Anaconda	Anaconda Copper Mining Co	Blister.
Butte	East Butte Copper Mining Co	Do.
Great Falls	Anaconda Copper Mining Co	Blister and electrolytic.
Nebraska: Omaha	American Smelting & Refining Co	Blister.
Nevada: McGill	Nevada Consolidated Copper Co	Do.
New Jersey:[a]		
Chrome	United States Metals Refining Co	Blister and electrolytic.
Maurer	American Smelting & Refining Co	Blister, electrolytic, and casting.
Newark	Balbach Smelting & Refining Co	Casting.
Perth Amboy	Raritan Copper Works	Electrolytic and casting.
New York: Laurel Hill	Nichols Copper Co	Blister, electrolytic, and casting.
Tennessee:		
Copperhill	Tennessee Copper Co	Blister.
Isabella	Ducktown Sulphur, Copper & Iron Co. (Ltd.)	Do.
Texas: El Paso	American Smelting & Refining Co	Do.
Utah:		
Garfield	Garfield Smelting Co	Do.
International	International Smelting Co	Do.
Virginia: West Norfolk	Norfolk Smelting Co	Do.
Washington: Tacoma	American Smelting & Refining Co	Blister and electrolytic.
British Columbia:		
Anyox	Granby Consolidated Mining, Smelting & Power Co.	Blister.
Trail	Consolidated Mining & Smelting Co. of Canada	Electrolytic.

[a] This list does not include a smelter in New Jersey and one in Pennsylvania, both of which make blister from material solely of foreign origin.

During the year 35 copper smelting and refining plants treated material from the United States; of these, 33 were domestic plants and 2 were foreign.

The figures of production represent the actual smelter recovery. For Michigan it is the sum of furnace-refined copper and copper cast into anodes for electrolytic refining. As to blister copper, the figures represent the fine copper content. Some casting and electrolytic copper is produced direct from ore or matte, and this is included in the smelter production.

MINE RETURNS.

The figures of mine production are based on reports furnished to the United States Geological Survey by all mines producing copper in 1920. These mines reported 1,224,550,151 pounds of copper.

The mines and smelters of several of the large copper producers are under the same management, and their production is reported on the same basis. The figures furnished by mines that ship to custom smelters or have only matting furnaces and ship their matte for conversion are likely to show considerable discrepancy from the smelter returns, as the mines may report a considerable quantity that has not yet reached the stage of blister copper by the end of the year and is consequently not included in the smelter production, or material that was reported by the mines in one year may be treated by the smelters in the following year. This discrepancy is more pronounced if a marked curtailment of production occurs at the beginning or the end of the year, so that there is not the balance of overlap that occurs if the industry is in normal condition throughout the year. Considerable copper is recovered by the smelters from ores that are treated primarily for other metals, the copper content being so low that it is not paid for and consequently is not always reported by the mines.

The difference between the smelter and the refinery production is accounted for entirely by an increase in the stocks of blister copper plus the copper content of bluestone produced and the loss in refining.

Copper produced from domestic ores as reported by mines, smelters, and refineries, 1916–1920, in pounds.

Year.	Mine.	Smelter.	Refinery.
1916	2,005,875,312	1,927,850,548	1,888,752,199
1917	1,895,434,349	1,886,120,721	1,873,546,171
1918	1,910,022,841	1,908,533,595	1,882,874,191
1919	1,212,334,041	1,286,419,329	1,433,485,795
1920	1,224,550,151	1,209,061,040	1,182,423,240

It appears that although theoretically the output reported by the mines should be considerably in excess of that reported by the smelters, this difference in the last 15 years has been nearly balanced by copper recovered from lead, zinc, gold, silver, and sulphur ores, which carry so little copper that it is not paid for and consequently has not usually been reported by the mines.

PRODUCTION BY STATES.

Eighteen States and one Territory contributed to the smelter production of copper in 1920. The subjoined table shows the mine and the smelter output of individual States for 1919 and 1920.

According to smelter returns, the four leading States—Arizona, Montana, Michigan, and Utah—produced 82 per cent of the total output in 1920, as compared with 80 per cent in 1919; and the eight leading States, including the four named and Alaska, Nevada, New Mexico, and Tennessee, produced 98 per cent of the total output in 1920.

Copper produced in the United States in 1919 and 1920, according to smelter and mine returns, by States, in pounds.

State.	1919		1920			
			Smelter returns.			
	Smelter returns.	Mine returns.	Rank.	Percentage of total.	Quantity.	Mine returns.
Alaska	56,534,992	47,220,771	5	5.47	66,093,924	70,435,363
Arizona	536,515,368	538,100,844	1	45.74	552,988,731	558,256,302
California	23,548,698	21,732,507	9	.98	11,822,028	12,626,272
Colorado	4,892,558	3,560,207	10	.35	4,282,616	4,043,734
Georgia	8,306	8,306	18	.....	3,663	5,780
Idaho	3,966,655	3,122,763	13	.16	1,922,116	2,538,396
Maine	376,186	376,186	.....	.....	.....	.....
Michigan	177,594,135	178,826,486	3	12.70	153,483,952	154,695,073
Missouri	588,570	1,617,200	15	.04	533,368	1,512,539
Montana	176,289,873	169,981,288	2	14.70	177,743,747	177,059,260
Nevada	64,683,734	52,331,175	6	4.60	55,580,322	50,559,763
New Mexico	60,377,320	51,150,541	7	4.31	52,159,751	54,400,691
North Carolina	3,334	3,334	.....	.....	.....	.....
Oregon	2,808,017	2,214,815	11	.21	2,529,311	2,355,276
Pennsylvania	.....	.....	14	.05	618,361	405,092
South Carolina	2,297	2,299	.....	.....	.....	.....
South Dakota	8,631	.....	19	.....	2,190	.....
Tennessee	15,629,454	15,623,589	8	1.38	16,727,803	16,727,803
Texas	2,153	979	17	.....	14,217	14,435
Utah	143,836,304	124,061,807	4	9.13	110,357,748	116,931,238
Vermont	582,561	582,468	.....	.....	.....	.....
Washington	2,552,134	1,676,576	12	.18	2,125,586	1,983,134
Wyoming	150,051	139,900	16	.....	24,256	.....
Undistributed	15,467,998	.....	.....	.....	47,350	.....
	1,286,419,329	1,212,334,041	.....	100.00	1,209,061,040	1,224,550,151

In the distribution of the blister output to the States of origin it is necessary to have reports not only from blister producers but also from matte smelters, as the matte is credited by the smelter that converts it to the State from which it was received, although the matte smelter may have received its ores from several States. In the adjustment of the products of these matte smelters slight errors in the distribution of the blister production are probably introduced. Likewise, the distribution of copper derived from zinc residues is subject to some error.

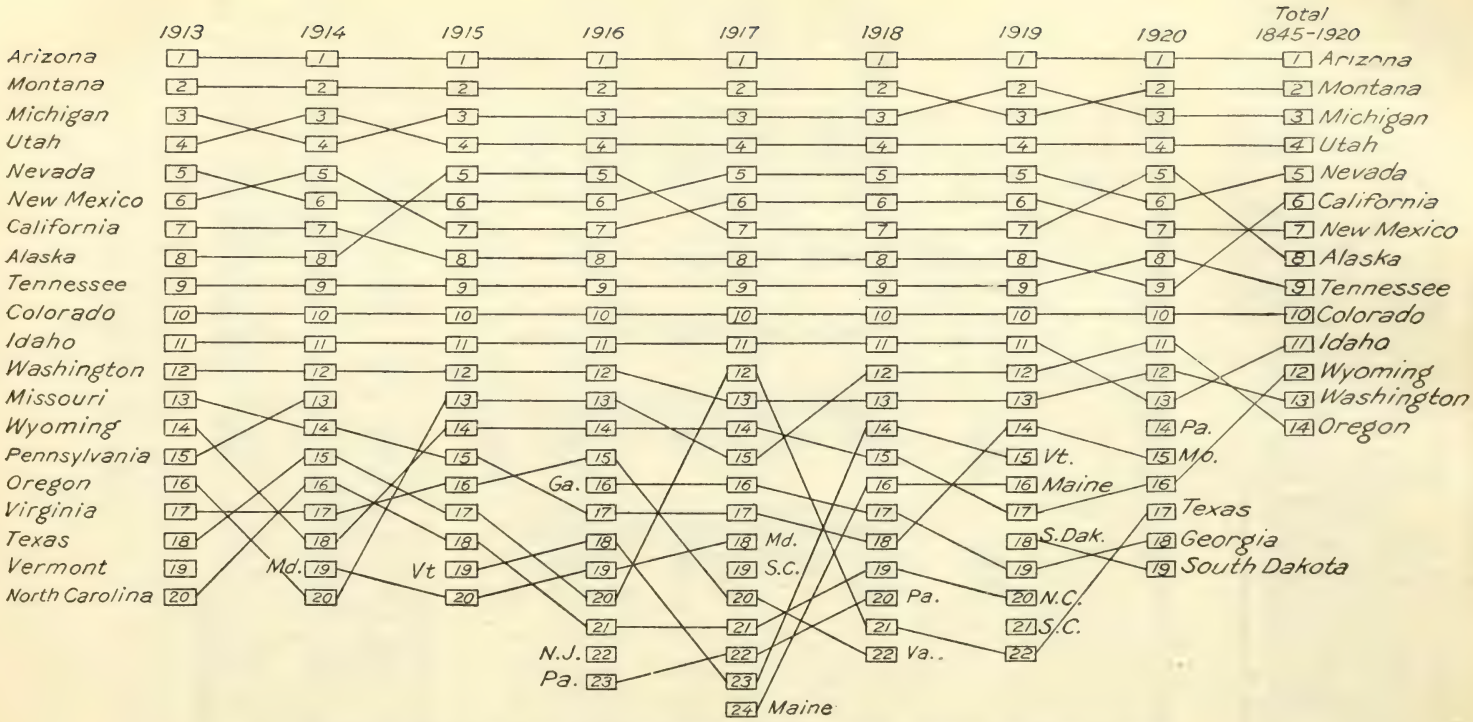


FIGURE 16.—Chart showing rank of States producing copper, 1845–1920. Prepared by Helena M. Meyer.

Copper produced in the United States, 1845–1920, by States.

[Smelter output.]

State.	Quantity (pounds).	Percentage.	Rank.
Alaska	598,449,470	2.02	8
Arizona	8,345,760,277	28.19	1
California	780,278,170	2.64	6
Colorado	284,012,588	.96	10
Idaho	112,478,992	.38	11
Michigan	6,860,460,103	23.18	3
Montana	8,011,923,265	27.06	2
Nevada	942,379,318	3.18	5
New Mexico	698,126,486	2.36	7
Oregon	15,274,960	.05	14
Tennessee	[a] 383,469,000	1.30	9
Utah	2,362,731,002	7.98	4
Washington	17,096,412	.06	13
Wyoming	31,575,290	.11	12
Other States and unapportioned	158,054,139	.53	.....
	29,602,069,472	100.00	.....

[a] Approximate production.

The table on page 453 shows the production from 1916 to 1920. The report for 1915 contains a table showing the production of copper by the different States from 1845.

The figures in the first column of the preceding table show the copper output of each important copper-producing State since the beginning of the industry. Some copper was produced in New Mexico in the early years of the last century, but the exact quantity is not known, though it was not large as measured by the present production. Prior to 1845, also, a little copper was produced in Michigan and a considerable quantity in the Eastern States.

Under "Other States and unapportioned" is included some copper assigned to "lead desilverizers" in the earlier reports of the Survey. This should properly be credited to some of the Western States. The output of the Central States, except Michigan, is also included under this head. Statistics for the individual Eastern States have not been compiled, but Tennessee, Vermont, and Virginia have made the largest contributions, and some copper has been produced by practically all the Appalachian States.

Arizona, Montana, and Michigan are the three chief copper-producing States. Arizona ranks first, with more than 28 per cent of the entire output of the country; Montana ranks second, with more than 27 per cent; and Michigan ranks third, with more than 23 per cent. The three leading States have produced 78 per cent of the total. Utah ranking next in order, has produced about 8 per cent of the total.

Mine production of copper in the principal districts in 1920.

District or region.	State.	Mine output (pounds).	Percentage of total production.	Rank.
Butte	Montana	176,399,000	14.41	1
Globe-Miami	Arizona	176,215,000	14.39	2
Lake Superior	Michigan	154,695,000	12.63	3
Bisbee (Warren)	Arizona	118,448,000	9.67	4
Bingham	Utah	110,670,000	9.04	5
Jerome	Arizona	107,084,000	8.74	6
Copper River	Alaska	55,998,000	4.57	7
Ely (Robinson)	Nevada	48,348,000	3.95	8
Ray (Mineral Creek)	Arizona	47,531,000	3.88	9
Santa Rita (Central)	New Mexico	44,400,000	3.63	10
Ajo	Arizona	40,104,000	3.28	11
Morenci-Metcalf	do	35,746,000	2.92	12
Ducktown	Tennessee	16,728,000	1.37	13
Prince William Sound	Alaska	13,768,000	1.12	14
Plumas County	California	9,579,000	.78	15
Pioneer	Arizona	9,299,000	.76	16
Burro Mountain	New Mexico	6,606,000	.54	17
Big Bug	Arizona	5,016,000	.41	18
Planet	do	3,457,000	.28	19
Silver Bell	do	3,382,000	.28	20
Banner	do	3,357,000	.27	21
Tintic	Utah	3,003,000	.25	22
Lordsburg	New Mexico	2,696,000	.22	23
San Juan-Ouray-San Miguel counties	Colorado	2,397,000	.20	24
Baker County	Oregon	2,355,000	.19	25
Foothill belt	California	2,201,000	.18	26
Agua Fria (Yavapai)	Arizona	1,973,000	.16	27
Courtland (Turquoise)	do	1,763,000	.14	28
Alder Creek	Idaho	1,499,000	.12	29
Lake-Eagle counties	Colorado	1,317,000	.11	30
Cochise	Arizona	1,150,000	.09	31
Index	Washington	1,111,000	.09	32
Ophir	Utah	1,095,000	.09	33
Yerington	Nevada	1,046,000	.09	34

As shown in this table, 34 districts in 1920 each produced 1,000,000 pounds or more of copper.

In the following table the statistics for the later years are compiled from reports furnished to the United States Geological Survey by the producing companies and those for the earlier years are taken mainly from reports on the several districts by members of the Survey:

Blister copper produced in the principal districts to the end of 1920.

District.	State.	Date production began.	Quantity (pounds).	Percentage of total production.	Rank.
Butte	Montana	1868	7,967,050,000	26.91	1
Lake Superior	Michigan	1845	6,845,803,000	23.13	2
Bisbee	Arizona	1880	2,788,370,000	9.42	3
Bingham	Utah	1896	2,037,080,000	6.88	4
Globe-Miami	Arizona	1881	1,621,817,000	5.48	5
Morenci-Metcalf	do	1873	1,502,677,000	5.08	6
Jerome	do	1883	1,314,537,000	4.44	7
Ely (Robinson)	Nevada	1908	816,383,000	2.76	8
Santa Rita (Central)	New Mexico	1800	617,645,000	2.09	9
Ray (Mineral Creek)	Arizona	1911	575,336,000	1.94	10
Shasta County	California	1897	573,819,000	1.94	11
Ducktown	Tennessee	1850	383,469,000	1.30	12
Foothill belt	California	1862	155,045,000	.52	13
Tintic	Utah	1880	152,779,000	.52	14

Fourteen districts in eight States have each contributed in excess of 150,000,000 pounds to the copper output of the country. Five of these districts are in Arizona, 2 each in California and Utah, and 1 each in Montana, Michigan, Nevada, New Mexico, and Tennessee. Two districts stand out prominently. They are the Butte district, Mont., which has produced 26.91 per cent of the output of the country, and the Lake Superior district, Mich., which has produced 23.13 per cent of the total output. Bisbee, Ariz., ranking third, has yielded 9.42 per cent of the total. The 14 districts have yielded 92 per cent of the total output of the United States since 1845.

QUANTITY AND ESTIMATED RECOVERABLE CONTENT OF COPPER-BEARING ORES.

The following tables show the quantity and the estimated recoverable content in copper of the ore produced by the mines of the United States in 1920. The figures are taken from the mines reports in Mineral Resources. The close agreement between the output as reported by the smelters and the recoverable quantity as reported by the mines indicates that the recoverable tenor is very close to the actual recovery. The classification of some of the complex western ores is difficult and more or less arbitrary. Under copper ores are classed not only those which contain 2.5 per cent or more of copper, but those which contain less than this percentage if their principal value is in copper. Under copper-lead and copper-zinc ores are classed complex ores in which copper is a valuable constituent. Considerable copper was reported by the mines from ores mined primarily for other metals, including siliceous gold and silver ores, lead ores, zinc ores, pyritic sulphur ores, and ores concentrated for their content of other metals. No attempt has been made to compile tables showing the quantity and recoverable content of this group of copper-bearing ores, but together with old slags and other materials they yielded a total of 21,679,883 pounds of copper.

Copper produced in the United States in 1920 from ores in which copper constitutes the principal value.

State.	Copper ore.	Copper in ore.		Gold in ore.	Silver in ore.	Value in gold and silver per ton.
		Quantity.	Percentage.			
	Short tons.	*Pounds.*		*Fine ounces.*	*Fine ounces.*	
Alaska	765,018	70,398,442	4.60	912.72	681,991	$1.00
Arizona	14,516,580	557,364,143	1.92	76,402.41	3,716,246	.39
California	346,201	12,489,269	1.80	1,860.45	179,752	.68
Colorado	3,835	383,427	5.00	2,150.54	100,643	40.20
Idaho	19,259	1,738,541	4.51	1,418.69	52,029	4.47
Michigan	5,938,967	154,695,073	1.30	.....	470,189	.25
Montana	4,002,491	172,581,159	2.16	18,720.88	6,030,507	1.74
Nevada	2,616,237	49,858,120	.95	22,924.19	82,977	.22
New Mexico	2,090,711	52,462,145	1.25	5,992.17	104,814	.11
Oregon	34,804	2,353,276	3.38	8,322.00	18,890	5.53
Tennessee	589,853	16,727,803	1.42	282.02	110,719	.21
Texas	227	14,435	3.18	.....	2,800	13.44
Utah	5,778,373	108,645,375	.94	31,845.51	452,915	.20
Washington	62,814	1,975,604	1.57	223.59	146.820	2.62
Total and average	36,765,370	1,201,686,812	1.63	171,055.17	12,151,292	.46

Copper ores concentrated, smelted, and leached and copper produced from each class of ore in the United States in 1920.

State.	Ore concentrated.			
	Quantity.	Concentrates produced.	Copper in concentrates.	Percentage of copper.
	Short tons.	*Short tons.*	*Pounds.*	
Alaska	732,549	80,342	50,996,706	3.48
Arizona	10,185,491	618,645	254,663,629	1.25
California	342,393	21,319	11,644,411	1.70
Idaho	2,912	289	105,159	1.81
Michigan	5,938,967	[a] 140,877	[b] 154,695,073	1.30
Montana	3,883,851	757,981	163,928,028	2.11
Nevada	2,594,466	351,802	48,048,849	.93
New Mexico	2,069,292	168,217	50,560,611	1.22
Oregon	34,804	7,910	2,353,276	3.38
Utah	5,502,395	318,057	101,848,546	.93
Washington	61,220	4,089	1,743,395	1.42
Total and average	31,348,340	2,469,528	840,587,683	1.34

State.	Ore leached.[c]			Ore smelted.		
	Quantity.	Copper produced.	Percentage of copper.	Quantity.	Copper produced.	Percentage of copper.
	Short tons.	*Pounds.*		*Short tons.*	*Pounds.*	
Alaska				32,469	19,401,736	29.88
Arizona	1,968,839	43,786,539	1.11	2,362,250	258,913,975	5.48
California				3,808	844,858	11.09
Colorado				3,835	383,427	5.00
Idaho				16,347	1,633,382	5.00
Montana	42,910	2,338,397	2.72	75,730	6,314,734	4.17
Nevada	350	6,500	.93	21,421	1,802,771	4.21
New Mexico				21,419	1,901,534	4.44
Tennessee				589,853	16,727,803	1.42
Texas				227	14,435	3.18
Utah	204,422	2,164,036	.53	71,556	4,632,793	3.24
Washington				1,594	232,209	7.28
Total and average	2,216,521	48,295,472	1.09	3,200,509	312,803,657	4.89

[a] Includes concentrates from sands.
[b] Includes copper from sands.
[c] Does not include old tailings treated.

Copper produced from copper-lead and copper-zinc ores in the United States in 1920.

State.	Copper-lead and copper-zinc ores.	Copper in ore.	Percentage of copper.
	Short tons.	*Pounds.*	
Arizona	5,108	173,660	1.70
Colorado	453	30,865	3.41
Georgia	240	5,780	1.20
Idaho	5,015	69,791	.70
Montana	3,032	86,472	1.43
Nevada	6,269	374,745	2.99
New Mexico	294	29,289	4.98
Utah	6,389	407,397	3.19
Washington	90	5,457	3.03
Total and average	26,890	1,183,456	2.20

Copper derived from ores classed as copper-bearing (copper, copper-lead, and copper-zinc ores), and total production of copper from all sources in the United States in 1920.

State.	Ore treated.	Copper recovered.	Percentage of copper.	Copper from all sources, including old slags, smelter cleanings, and precipitates.
	Short tons.	*Pounds.*		*Pounds.*
Alaska	765,018	70,398,442	4.60	70,435,363
Arizona[a]	14,521,688	557,537,803	1.92	558,256,302
California	346,201	12,489,269	1.80	12,626,272
Colorado[b]	4,288	414,292	4.83	4,043,734
Georgia	240	5,780	1.20	5,780
Idaho	24,274	1,808,332	3.72	2,538,396
Michigan	5,938,967	154,695,073	1.30	154,695,073
Missouri				1,512,539
Montana[c]	4,005,523	172,667,631	2.16	177,059,260
Nevada	2,622,506	50,232,865	.96	50,559,763
New Mexico[d]	2,091,005	52,491,434	1.26	54,400,691
Oregon	34,804	2,353,276	3.38	2,355,276
Pennsylvania				405,092
Tennessee	589,853	16,727,803	1.42	16,727,803
Texas	227	14,435	3.18	14,435
Utah	5,784,762	109,052,772	.94	116,931,238
Washington	62,904	1,981,061	1.57	1,983,134
Total and average	36,792,260	1,202,870,268	1.63	1,224,550,151

[a] A quantity of copper was recovered from old slags and ores not classed as copper ores.
[b] Most of the copper from Colorado is derived from ores classed as siliceous ores and lead ores.
[c] Considerable copper was recovered as precipitates from mine waters and from ores not classed as copper ores.
[d] A quantity of copper was derived from ores classed as lead ores and siliceous ores.

Copper ores produced in the United States, 1916–1920, and average yield in copper, gold, and silver.

Year.	Smelting ores.		Concentrating ores.		Total.				
	Quantity.	Yield in copper.	Quantity.	Yield in copper.	Quantity.	Yield in copper.	Yield per ton in gold.	Yield per ton in silver.	Value per ton in gold and silver.
	Short tons.	*Per cent.*	*Short tons.*	*Per cent.*	*Short tons.*	*Per cent.*	*Ounce.*	*Ounce.*	
1916	6,928,010	4.72	50,935,355	1.28	57,863,365	1.70	0.0069	0.424	$0.42
1917	7,438,068	4.39	51,044,626	1.19	58,482,694	1.60	.0058	.347	.49
1918	6,223,674	4.51	53,937,796	1.18	62,289,069	1.51	.0050	.328	.50
1919	3,465,880	4.64	30,769,966	1.35	36,121,622	1.65	.0052	.356	.51
1920	3,200,509	4.89	31,348,340	1.34	36,765,370	1.63	.0047	.331	.46

The output of copper-bearing ores in 1920 showed a slight increase compared with that of 1919. For the last 15 years there has been a steady increase in production of these ores except in 1914 and 1919. Arizona is the largest producer of copper ore, followed in order by Michigan, Utah, Montana, Nevada, New Mexico, Alaska, Tennessee, and California. In the output of smelting ore Arizona is first, followed by Tennessee, Montana, Utah, Alaska, Nevada, and New Mexico. In the output of concentrating ore Arizona is first, followed by Michigan, Utah, Montana, Nevada, and New Mexico.

ESTIMATED AVERAGE RECOVERABLE COPPER CONTENT OF COPPER ORES.

In previous years the discussion of quantity of copper recovered from ores has been given under the heading "Yield of copper from ores." This title is misleading, as the figures do not represent actual yield but estimates of the recoverable content of ore based upon assays. It is impossible to determine the actual yield for any year, on account of the lapse of time between shipment from the mines and actual smelting of the ore. Mixing of different ores to prepare proper smelter charges introduces another difference between actual recovery and estimated recoverable content. In some cases less than the estimated recoverable content is recovered, and in others more.

The estimated average recoverable content of copper in copper ore in 1920 was 1.63 per cent—slightly less than in 1919. The average yield from direct smelting ores increased and that from concentrating ores decreased slightly.

Of the principal copper-producing States Alaska showed the highest recoverable content of copper from ore, followed in order by Montana, Arizona, California, Tennessee, Michigan, New Mexico, Nevada, and Utah. Of the States producing smelter ore in large quantity Alaska had the highest recoverable content, followed by Arizona, New Mexico, Nevada, Montana, Utah, and Tennessee. Of the States producing concentrating ores in large quantity Montana had the highest recoverable content, followed by Michigan, Arizona, New Mexico, Nevada, and Utah.

The average value of the gold and silver recovered from copper ores in 1920 was 46 cents to the ton. Its ratio to the value of the copper was a little less than in the three preceding years. Among the principal copper-producing States Montana was first in the average yield of gold and silver, followed by Alaska, Arizona, Michigan, Nevada, Utah, and New Mexico.

REVIEW BY STATES.

SCOPE OF DISCUSSION.

In the following pages a brief statement of the conditions affecting production in the principal copper districts of the country is presented, and the tenor of the ore from each district is given, so far as it does not disclose the production of those individual companies whose figures of output have not already been published in their annual reports or elsewhere. More detailed information on the mining operations of the districts is given in the reports on mine production listed in the prefatory note.

Figures of metal output, ore reserves, metal content, and recovery in treatment of individual companies given in this report, unless otherwise stated, are quoted from the official reports of the companies.

The report for 1915 contains a map showing the location of the copper-producing districts and the metallurgic plants and also a brief discussion of the geologic occurrence of the ores in the different districts. Copies of that report may be obtained on application to the Director of the United States Geological Survey.

ALASKA.

The production of blister copper from Alaska in 1920 was 66,093,924 pounds, as compared with 56,534,992 pounds in 1919. The mine production of copper in 1920 was 70,435,363 pounds.

Alaska began to produce copper in notable quantity about 1903, and since that time it has been a steady contributor. Its total production of blister copper to the end of 1920 is 598,449,470 pounds. The output in 1920 came from the Ketchikan, Prince William Sound, and Copper River districts.

Ketchikan district.—The copper mines in the Ketchikan district yielded 16,088 tons of ore, from which 670,155 pounds of copper was produced.

Prince William Sound district.—The production of copper in the Prince William Sound district increased from 10,300,281 pounds in 1919 to 13,767,548 pounds in 1920. The ores of the district were shipped to the Tacoma and Anyox smelters. Besides the copper, the 454,534 tons of ore treated yielded 119,167 ounces of silver.

From the Beatson mine of the Kennecott Copper Corporation was mined and milled 451,463 tons of ore, averaging 1.77 per cent of copper. Concentrates amounted to 44,268 tons, averaging 15 per cent of copper. The average recovery was 82.85 per cent, this being a slight improvement over previous years.

Copper River district.—The Bonanza and Jumbo mines of the Kennecott Copper Corporation were the largest producers in the Copper River district. Their output was 223,009 tons of ore, averaging 9.04 per cent of copper; 199,656 tons of ore milled averaged 6.82 per cent of copper. Concentrates amounted to 21,696 tons, averaging 51.06 per cent. The average recovery was 82.29 per cent. The leaching plant treated 190,327 tons of tailings, averaging 1.14 per cent of copper, with a recovery of 3,332,500 pounds of copper. The total average milling recovery for the year, including leaching-plant operations, was 90.10 per cent. The Kennecott mill also treated 67,567 tons of ore for the account of the Mother Lode Coalition Mines Co., of the Chitina district.

The total recovery from the Copper River and Beatson output was 51,365,261 pounds of refined copper and 507,727 ounces of silver. Profit on metal sold by the Kennecott Copper Corporation amounted to $3,259,388, and total profits, including dividends on stock held by the company, amounted to $6,477,021. Dividends were paid to the amount of $2,787,081, and in addition a capital distribution of $2,787,081 was made.

ARIZONA.

Inclusive of 1920, Arizona has made a recorded production of 8,345,760,277 pounds of copper, which represents 28.19 per cent of the total production of the United States since 1845. In 1920 the production was 552,988,731 pounds, or 45.74 per cent of the United States total for the year. The greater part of the production has come from five copper mining districts, which are, in the order of their total output, Bisbee, Globe-Miami, Morenci-Metcalf, Jerome, and Ray or Mineral Creek. Ten of the 13 copper-smelting plants within the State were operated in 1920.

Bisbee district.—The Phelps Dodge Corporation was, as usual, the largest producer in the Bisbee district, and its production was 71,443,396 pounds.

Copper produced in Bisbee district, Ariz., 1916–1920.

Year.	Quantity.	Average yield in copper.	Value in gold and silver per ton.
	Pounds.	*Per cent.*	
1916	193,600,000	4.9	$1.51
1917	167,600,000	5.0	1.56
1918	160,456,000	4.9	1.62
1919	122,311,000	4.87	2.21
1920	118,448,000	4.06	1.81

The production of the Copper Queen branch of the Phelps Dodge Corporation, as summarized in the company's report, is as follows:

Metals produced by Copper Queen branch of Phelps Dodge Corporation, 1920.

Production of mines.

	Ore, dry weight.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Ounces.*	*Ounces.*	*Pounds.*	*Pounds.*
Underground—Copper	569,307	8,628	476,961	65,713,706	.....
Underground—Lead	827	54	6,095	15,354	243,836
Total underground	570,134	8,682	483,056	65,729,060	243,836
Steam shovel—high grade	27,363	164	3,582	1,146,769	.....
Steam shovel—low grade	233,914	.....	.....	4,240,286	.....
Total steam shovel	261,277	164	3,582	5,387,055	.....
Precipitates	507	.....	60	327,281	.....
Manganese ore	254	.....	.....	.....	.....
Total production	832,172	8,846	486,698	71,443,396	243,836

Production of reduction works.

	Ore, dry weight.	Gold.	Silver.	Copper.
	Short tons.	*Ounces.*	*Ounces.*	*Pounds.*
Copper Queen branch	549,121	8,596	413,410	60,512,125
Burro Mountain branch	16,544	70	11,414	3,825,019
Moctezuma Copper Co.	107,010	3,552	446,079	24,338,143
Calumet and Arizona Co. exchange ore	44,475	2,004	72,788	2,345,408
All other	70,835	3,047	699,424	4,161,470
	787,985	17,269	1,643,115	95,182,165

Under an arrangement made with the Calumet & Arizona Mining Co. in the early part of the year whereby the Phelps Dodge Corporation was to ship to that company siliceous ores in exchange for sulphide ores, this corporation shipped 77,792 tons containing 4,747,033 pounds of copper and received for the account of the Calumet & Arizona Mining Co. 62,654 tons containing 3,753,889 pounds of copper.

Metals produced by Copper Queen Consolidated Mining Co., 1916–1920.

Year.	Ore.	Copper.	Silver.	Gold.	Lead.
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*	*Pounds.*
1916	951,978	102,685,722	1,096,136	24,030	9,421,562
1917	800,970	93,618,409	828,665	19,156	6,870,128
1918	771,063	90,988,156	558,433	16,409	1,234,497
1919	606,386	68,614,002	492,326	10,813	9,372
1920	832,172	71,443,396	486,698	8,846	243,836

Production from the limestone mines of the Copper Queen branch was further curtailed, but the stripping of Sacramento Hill and the erection of the concentrator proceeded actively. The company expected that the mill and the porphyry deposit known as the West ore body would be ready for productive operation by January 1, 1922, with an initial capacity of 4,000,000 pounds a month. An intensive development campaign has resulted in placing the ore reserves in a much better condition to meet an increased demand for copper.

Including copper received from other sources, 227,584,468 pounds was sold and delivered to buyers at an average price of 18.337 cents a pound net cash f. o. b. New York in 1920, as compared with 149,284,465 pounds at an average price of 17.13 cents a pound in 1919. The increased sale of copper was due to the increased demand which prevailed during the first part of 1920.

Metals produced by Calumet & Arizona Mining Co., 1916–1920.

Year.	Ore smelted.	Copper produced.	Copper recovered.	Gold.	Silver.	Dividends.
	Short tons.	*Pounds.*	*Per cent.*	*Ounces.*	*Ounces.*	
1916	845,286	70,702,028	4.17	31,673	1,267,734	$5,777,296
1917	.....	59,131,512	.....	27,947	906,038	6,424,762
1918	.....	50,909,373	.....	31,308	906,210	5,140,062
1919	.....	44,991,107	.....	28,530	995,366	1,927,563
1920	.....	42,430,847	.....	32,520	932,489	2,570,084

At the reduction works at Douglas 591,914 tons of ore was treated. The sulphuric-acid plant produced 39,996 tons of 60° Baumé acid.

The net income for the year was $1,849,202. Regular dividends for the year amounted to $2,570,084. Total dividends to the end of 1919 amounted to $45,630,471.

The mines were operated at less than 60 per cent of normal capacity throughout the year. After a slight increase in production in the summer, due to the increased demand for copper, a still more drastic curtailment was made in November and December. The company claims that though no large ore bodies were found, developments in the Waddell, Last Rose of Summer, Comet, and Bengal claims are very promising.

The Shattuck Arizona Copper Co. continued to curtail its production during 1920, owing to conditions in the copper market and discontinued operations entirely early in November.

Metals produced by Shattuck Arizona Copper Co., 1916–1920.

Year.	Copper.	Silver.	Gold.	Lead.	Copper recovered.	Dividends.
	Pounds.	*Ounces.*	*Ounces.*	*Pounds.*	*Per cent.*	
1916	18,161,763	314,918	4,721	3,413,445	5.38	$1,662,500
1917	11,935,317	154,344	1,542	2,010,145	4.57	612,500
1918	9,081,959	161,230	1,220	2,420,690	4.83	437,500
1919	2,111,841	89,724	300	4,432,655	4.74	*a* 262,500
1920	2,374,148	73,718	575	8,254,603	6.19	.....

a Capital distribution through 1920 to the amount of $1,487,500.

Mine and smelter production of Shattuck Arizona Copper Co., 1920, in short tons.

	Copper ore.		Lead ore.	
	Wet.	Dry.	Wet.	Dry.
Ore stoped	19,997	18,604	94,069	89,840
Ore developed	408	379	2,760	2,637
Ore from dumps, etc	158	157	.....	.....
Ore mined	20,563	19,140	96,829	92,477
Ore shipped	20,519	19,082	96,985	92,624
Ore smelted and treated	20,622	19,175	97,440	93,061

Copper recovered	pounds..	2,374,148
Gold recovered	ounces..	575
Silver recovered	do....	73,718
Lead recovered from concentrates	pounds..	8,254,603
Gold recovered from concentrates	ounces..	4,377
Silver recovered from concentrates	do....	326,609
Lead recovered, direct shipments	pounds..	25,075
Gold recovered, direct shipments	ounces..	19
Silver recovered, direct shipments	do....	1,299
Cost per pound of refined copper.		
Gross operating cost	cents..	27.421
Less operating credits	do....	3.847
Net operating cost	do....	23.524

Globe-Miami district.—Inclusive of 1920, the Globe-Miami district has produced 1,621,817,000 pounds of copper, which represents 5.48 per cent of the total output of the United States since 1845. The district ranks fifth in the country and second in the State. The Miami part of the district did not make a notable output until 1911.

Copper produced in Globe-Miami district, Ariz., 1916–1920.

Year.	Copper.	Yield of ore in copper.
	Pounds.	*Per cent.*
1916	220,000,000	1.43
1917	169,490,000	1.42
1918	201,806,000	1.31
1919	171,106,000	1.36
1920	176,215,000	1.29

The chief producers of the district are the Inspiration Consolidated Copper Co., the Miami Copper Co., the Old Dominion Co., and the Arizona Commercial Co. The same condition prevailed in this district as in the others. Production was maintained at a greatly decreased rate, and most companies devoted considerable time and funds to development and prospecting.

Ore produced by Old Dominion Co., 1920.

	Quantity (short tons).	Percentage of copper.
Smelting ore	64,810	6.63
Concentrating ore	182,606	4.15
Converting ore	1,695	3.39
	249,111	4.79

Metals produced by Old Dominion Co., 1916–1920.

Year.	Ore.	Copper.	Gold.	Silver.	Average yield in copper.	Cost per pound of copper.	Dividends
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*	*Per cent.*	*Cents.*	
1916	152, 059	17, 654, 643	1, 240	60, 688	5. 88	11. 69	$1, 944, 000
1917[a]	199, 888	32, 365, 795	3, 897	165, 703	4. 97	.....	2, 376, 262
1918	230, 451	33, 378, 158	5, 071	184, 982	4. 52	.....	1, 188, 284
1919	253, 686	28, 166, 396	5, 756	137, 071	4. 28	.....	.....
1920	249, 111	22, 854, 452	3, 484	181, 010	4. 79	.....	.....

[a] Includes custom ores.

Like other copper-producing companies the Old Dominion Co. experienced high costs of labor and supplies, and these, combined with higher freight rates, increased the cost of production. The company carried on an intensive and successful development campaign. The smelter of the Old Dominion Co. at Globe treated 135,216 tons, as compared with 111,533 tons in 1919.

The Miami Copper Co. operated during the year at approximately 75 per cent of normal capacity.

Copper produced by Miami Copper Co., 1916–1920.

Year.	Ore.	Copper content.	Mill extraction.	Refined copper.	Cost of copper per pound.	Dividends.
	Short tons.	*Per cent.*	*Per cent.*	*Pounds.*	*Cents.*	
1916	1, 842, 017	2. 07	73. 88	53, 518, 331	9. 52	$4, 295, 905
1917	1, 640, 206	2. 03	69. 25	43, 863, 669	12. 51	6, 537, 247
1918	2, 132, 941	2. 026	71. 15	58, 407, 563	14. 833	3, 362, 013
1919	1, 698, 446	2. 04	82. 38	54, 221, 638	15. 812	1, 867, 785
1920	1, 801, 958	1. 968	82. 48	55, 581, 328	11. 898	1, 494, 228

Milling operations of Miami Copper Co., 1920.

Ore milled	short tons	1, 801, 958
Copper in ore	per cent	1. 968
Concentrates produced	short tons	66, 684
Copper in concentrates	per cent	43. 868
	pounds	58, 506, 646
Copper recovered per ton of ore	do	32. 47
Mill extraction	per cent	82. 48

Cost of copper in concentrates f. o. b. cars at Miami, Ariz., 1920.

	Per ton of ore.	Per pound of copper.
Mining	$1. 30132	$0. 04220
Milling	. 82692	. 02681
General	. 39343	. 01276
	2. 52167	. 08177

Ore reserves of Miami Copper Co., Jan. 1, 1921.

	Quantity (short tons).	Percentage of copper.
High-grade sulphide ore	10, 723, 410	2. 26
Low-grade sulphide ore	36, 000, 000	1. 06
Mixed sulphide and oxide ore	6, 000, 000	2. 00
	52, 723, 410	.....

New development work during the year, particularly in the lower part of the main ore body of the Miami Copper Co., was extensive. This work resulted in adding 1,471,619 tons to the previous estimate of the high-grade ore body.

The cost of copper in concentrate on board cars at Miami was reduced 39 cents a ton, or approximately 1 cent a pound of copper produced.

The Inspiration Consolidated Copper Co. continued to operate at a greatly reduced rate in 1920 and produced 79,453,740 pounds of refined copper from 5,100,573 tons of ore, as compared with 78,038,306 pounds of copper from 4,175,632 tons of ore in 1919. No additional ore was developed, but the reserve was increased by the purchase of the Montgomery group of claims from the Warrior Copper Co. The experiments on leaching and flotation of mixed oxidized and sulphide ores, which were begun in 1919, were discontinued in March, 1920, owing to curtailment of operations. The company states that the results of these tests gave satisfactory assurance that its ores are amenable to such treatment and that the copper can be economically recovered. The cost of fine copper, including depreciation but excluding depletion and Federal taxes, amounted to 14.173 cents a pound.

Mill statistics, Inspiration Consolidated Copper Co., 1920.

Total ore milled	dry tons	5,078,338
Ore milled per day	do	14,067
Average number of sections running		14.2
Average rate per section	tons	993
Screen analysis of feed (on 48 mesh)	per cent	5.1
Assay mill feed	per cent of copper	1.139
Copper in feed, oxidized	per cent	0.227
Copper assay of general tailings	do	0.320
Copper in general tailings, oxidized	do	0.216
Copper in general concentrates, smelter assay	do	30.161
Copper in flotation concentrates	do	37.27
Copper in table concentrates	do	12.93
Moisture in general concentrates	do	16.53
Ratio of concentration		37.7
Recovery of copper (calculated from smelter assays):		
Assays only	per cent	72.68
Assays and weights of concentrates and ore	do	70.20
Assays and weights of concentrates and tailings	do	72.00
Assays and weights of ore and tailings	do	72.70
Recovery of copper sulphides	do	88.91
Water used per ton of ore	gallons	374.3
Power used per ton of ore milled:		
Coarse crushing	kilowatt-hours	0.48
Fine grinding and concentrating	do	9.91
Blowers for flotation air	do	1.96
Filtering and reclaiming water	do	1.17
Lighting	do	0.13
		13.65
Steel balls consumed per ton of ore milled	pounds	1.76
Flotation oil consumed per ton of ore milled:		
Coal tar	do	0.865
Other oils	do	0.143
		1.008

The Arizona Commercial Mining Co. operated its Copper Hill property continuously until December 16, when production was stopped and the mine was prepared for an indefinite shutdown. The Eureka property was idle during 1920. The company produced 7,913,836 pounds of refined copper, 31,028 ounces of silver, and 1,722 ounces of gold.

Copper produced by the Arizona Commercial Mining Co. in 1919 and 1920.

	1919		1920	
	Ore (dry tons).	Copper.	Ore (dry tons).	Copper.
		Per cent.		*Per cent.*
Smelting ore	11,393.388	9.113	14,289.300	10.04
Concentrating ore	65,168.934	4.941	63,683.587	5.22
Lease ore	9.964	11.900	.....	.....
	76,572.286	5.563	77,972.887	6.11

Morenci-Metcalf district.—Inclusive of 1920 the Morenci-Metcalf district has produced a total of 1,502,677,000 pounds, or 5.08 per cent of the total output of the country since 1845. In total production it ranks sixth among the copper districts of the country, and for 1920 it ranked twelfth.

Copper produced in Morenci-Metcalf district, 1916–1920.

Year.	Quantity.	Average yield of copper from ore.
	Pounds.	*Per cent.*
1916	75,977,000	1.89
1917	53,000,000	1.85
1918	71,867,000	1.71
1919	44,868,000	1.72
1920	35,746,000	1.73

The principal producers of the district are the Morenci branch of the Phelps Dodge Corporation and the Arizona Copper Co. The operations of the Morenci branch of the Phelps Dodge Corporation were confined to continuation of the prospecting and development campaign begun in September, 1919, which is reported to have resulted in a substantial increase in ore reserves. The Diesel power plant and compressor installed in 1919 was operated satisfactorily during the year.

Copper produced by Morenci branch of Phelps Dodge Corporation, 1916–1919.

Year.	Ore treated (short tons).	Copper produced.	
		Quantity (pounds).	Percentage.
1916	474,808	17,541,258	1.85
1917	333,263	13,202,201	1.98
1918	480,407	17,130,209	2.32
1919	253,208	11,414,031	2.25

The Arizona Copper Co. continued to operate on a curtailed basis during 1920. The company experienced difficulties from scarcity of skilled workmen, especially during the first part of the year, and the inefficiency of the lower class of workmen employed necessarily increased the cost of production. During the year the company purchased the Stevens group, consisting of 39 patented mining claims in the Metcalf district, which are regarded as favorable for finding additional ore bodies. It also continued the dismantling of the Shannon smelter. Since the fall of 1920 the Phelps Dodge Corporation has taken over the property of the Arizona Copper Co. under the following arrangements, quoted from the company's report covering the eight months ending May 31, 1921:

1. The whole undertaking (including the railway) is sold to the Phelps Dodge Corporation, excepting the Edinburgh office, for a sum of about £35,000, and the right (subject to making good if required certain expected Federal tax recoveries) to certain British tax recoveries.

2. The price is: (*a*) Payment of the dividends on the A preference shares and preference stock and retirement of these shares and stock (at the expense of that corporation) within five years. (*b*) Fifty thousand fully paid shares of $100 each of the corporation, of which the capital will then be 500,000 shares of $100 each. (*c*) The purchaser assumes all the liabilities, other than undisclosed contingent liabilities, not incurred in the ordinary course of business. It is believed that all liabilities have been disclosed.

3. The company is to have the right to nominate a director of the corporation.

It will thus be seen that, while the A preference shares and the preference stock will in the meantime remain, Phelps Dodge Corporation undertake liability for these shares and stock, and therefore in effect the ordinary shareholders of this company will own one-tenth of the capital stock of Phelps Dodge Corporation, and thus retain a one-tenth interest in the mining properties of this company.

Copper produced by Arizona Copper Co., 1916–1920.

Year ending Sept. 30.	Ore treated.	Copper produced.	Average yield.
	Short tons.	*Pounds.*	*Per cent.*
1916	905,486	34,100,000	1.803
1917	1,178,087	42,482,000	1.830
1918	1,095,568	40,442,000	1.754
1919	1,147,659	36,474,000	1.611
1920	1,046,331	35,692,000	1.642

Jerome district.—To the end of 1920 the Jerome district has produced 1,314,537,000 pounds of copper, or 4.44 per cent of the total output of the country since 1845. In total output it stands seventh among the copper districts of the country, and in production for 1920 it ranks sixth. The principal producers of the district are the United Verde Copper Co. and the United Verde Extension Mining Co.

Copper produced in the Jerome district, Ariz., 1916–1920.

	Pounds.		Pounds.
1916	102,000,000	1919	72,333,000
1917	145,900,000	1920	107,084,000
1918	133,781,000		

The United Verde Extension Mining Co. operated throughout the year but did no development work below the 1,400-foot level. The quantity of ore developed and remaining in the mine above the 1,500-foot level is 1,148,800 tons, averaging 11.81 per cent of copper and 0.023 ounce of gold and 2.22 ounces of silver to the ton.

Copper produced by the United Verde Extension Mining Co., 1918–1920.

Year.	Ore treated.	Copper produced.	Silver.	Gold.
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*
1918	133,355	55,491,077	503,739	3,046
1919	93,325	28,860,615	272,855	3,169
1920	161,617	41,942,700	359,370	5,530

Ray or Mineral Creek district.—During 1920 the Ray Consolidated Copper Co. continued to operate at an average of about 50 per cent of normal capacity. It increased its production in the second quarter in response to the increase in demand for copper and reduced its operations to less than 40 per cent of normal at the end of the year. Its development work was confined to opening sufficient new stoping area to compensate for the ore extracted. The total ore reserves on December 31, 1920, were 83,004,043 tons averaging 2.068 per cent of copper. The reserves were computed by deducting the quantity mined during the year from the ore reserves reported at the end of 1919. Mining costs for the company increased, owing to the increased costs of labor and supplies.

Copper produced by Ray Consolidated Mining Co., 1916–1920.

Year.	Ore milled.	Copper content.	Mill recovery.	Refined copper.	Cost per pound.[a]	Dividends and capital distributions.
	Short tons.	*Per cent.*	*Per cent.*	*Pounds.*	*Cents.*	
1916	3,332,340	1.607	70.20	74,983,540	10.267	$4,337,955
1917	3,560,900	1.635	74.53	88,582,649	12.229	6,624,151
1918	3,411,000	1.613	74.92	83,599,160	17.695	5,125,831
1919	1,621,600	1.814	79.45	46,011,371	15.62	3,154,358
1920	1,706,928	1.720	81.98	47,062,030	16.144	1,577,179

[a] Does not include value received for gold and silver.

Ajo district.—The principal producer in the Ajo district was the New Cornelia Copper Co. This company operated at nearly full capacity from February to October, but ordered a cut in production in November. An important change in the leaching process was effected in 1920, whereby a large part of the ferric iron in solution is reduced to ferrous iron, and a larger proportion of cement copper is returned to solution and recovered as electrolytic copper. This change and the success of the agitators for returning the cement copper to solution, together with an improvement in the solution, have resulted in a much greater recovery of copper from leaching solutions as electrolytic copper. Only 7 per cent of the copper from the leaching plant in 1920 was in the form of cement copper, as compared with 17.7 per cent in 1919 and 25.8 per cent in 1918. The cost of electrolytic copper from the leaching plant is about 3 cents less a pound than the cost of cement copper.

The cost of all copper from the leaching plant was nearly 1 cent a a pound less than in 1919, in spite of high wages, prices for supplies, taxes, and freight rates. Though this improvement was very largely due to the larger proportion of electrolytic copper, the crushing cost, leaching cost, and cost of electrolytic refining decreased considerably.

The flotation plant of the New Cornelia Copper Co. was closed on February 28, 1920. The following results were obtained on all ore treated during the experimental period:

Operations of the experimental concentrating plant of the New Cornelia Copper Co., in 1920.

Ore treated	wet tons	24,964.5
Do	dry tons	24,657.6
Mill feed:		
Copper as sulphide	per cent	1.298
Copper as oxide	do	0.034
Tailings:		
Copper as sulphide	do	0.206
Copper as oxide	do	0.021
Concentrates:		
Produced	dry tons	1,642.62
Total copper	per cent	16.808
Insoluble	do	34.82
Sulphur	do	18.63
Iron	do	22.03
Gold per ton	ounce	0.081
Silver per ton	do	0.85
Recovery	per cent	84.070
Recovery, sulphide copper	do	85.139
Recovery, silver	do	67.32
Recovery, gold	do	60.77
Ratio of concentration		15.011
Copper produced (estimated)	pounds	552,181

Copper produced by the New Cornelia Copper Co. in 1919 and 1920, in pounds.

	1919	1920
Electrolytic copper	29,640,211	37,331,586
Copper in cement copper shipped	6,368,952	2,113,985
Copper in ore shipped	3,500,298	249,353
Copper in concentrates shipped		409,569
	39,509,461	40,104,493

The concentrates yielded 98.79 ounces of gold and 1,016 ounces of silver.

Pioneer district.—The Pioneer district in Pinal County produced 9,299,000 pounds of copper in 1920, as compared with 10,549,000 pounds in 1919. The Magma Copper Co. is the largest producer in the district.

Copper ore mined and treated and milling results of the Magma Copper Co., 1920.

	Ore.	Copper.	Silver.	Gold.
	Short tons.	*Per cent.*	*Ounces.*	*Ounce.*
Total ore mined	100,872.0	4.928	3.412	0.0438
Hand-sorted crude product shipped direct to smelter	9,219.0	17.105	8.389	.1104
Mill heads	91,653.0	3.704	2.911	.0372
Concentrates produced	31,199.4	10.140	7.753	.1096
Average assay of mill tailings		.3817	.3754	Trace.

The mill recovery was 93.203 per cent of the total copper in the mill heads. The total copper recovered, including ore obtained by hand-sorting, was 95.359 per cent of the copper content of the run of

mine ore. The net production, deducting all smelting and refining losses, was 8,854,917 pounds of copper, 303,258 ounces of silver, and 4,437 ounces of gold.

Copper shipments of Magma Copper Co. from beginning of operations to end of 1920.

	Ore.	Copper.	Silver.	Gold.
	Short tons.	*Per cent.*	*Ounces.*	*Ounce.*
Copper concentrates	159,261.3146	11.6875	11.3854	0.1227
Crude sulphides	74,594.3030	16.5945	14.8756	.0993
Crude carbonate	4,433.6240	8.014	5.2660	.0550
	238,289.2416	13.1541	12.3641	.1141

The total production from the beginning of operations to the end of 1920 has been 62,689,494 pounds of copper, 2,946,249.92 ounces of silver, and 27,196.204 ounces of gold.

Estimated ore reserves of Magma Copper Co. at the end of 1920.

	Ore.	Gold per ton.	Silver per ton.	Copper.	Lead.	Zinc.
	Short tons.	*Ounce.*	*Ounces.*	*Per cent.*	*Per cent.*	*Per cent.*
Reasonably assured copper sulphide ore	827,000	0.02	3.0	5.00	.....	.....
Reasonably assured lead-zinc ore	20,000	.....	12.0	.....	2.0	13.5

Silverbell district.—The Silverbell district, in Pima County, has been a considerable producer of copper since 1904 and has produced about 62,000,000 pounds of copper. The production in 1920 was 3,382,000 pounds. The Silverbell mine, operated by the El Tiro Leasing Co., is the principal producer in the district.

Other districts.—Other districts in Arizona that made considerable production during 1920 are the Cochise, Courtland-Turquoise, Banner, Pima, Patagonia and Big-Bug, Peck, Planet, and Agua Fria. The copper produced in these districts is derived principally from lead, lead-zinc, silver, and siliceous ores, whose copper content is largely of secondary importance.

CALIFORNIA.

In 1920 California produced 11,822,028 pounds of blister copper, compared with 23,548,698 pounds in 1919. To the end of 1920 California has produced about 780,278,170 pounds of copper, or 2.64 per cent of the output of the country since 1845. In 1920 the output was 0.98 per cent of the total for the United States. In total output the State ranks sixth among the copper producers of the country and for 1920 it ranked ninth.

The copper has been derived chiefly from ores mined in the Shasta, Foothill, and Plumas districts, although numerous other districts have at various times, particularly in recent years, contributed some copper.

Shasta district.—The total production in the Shasta district, inclusive of the year 1920, was 573,819,000 pounds, or about 1.94 per cent of the total in the United States.

Copper produced in Shasta County district., Calif., 1916–1920.

Year.	Quantity.	Average yield of copper.	Gold and silver per ton.
	Pounds.	*Per cent.*	
1916	39,700,000	2.62	$2.59
1917	26,650,000	2.75	1.00
1918	25,030,000	2.76	1.52
1919	7,626,000	3.91	2.30
1920	514,000	3.35	6.37

The principal production in 1920 came from the Afterthought mine. The mine of the Mountain Copper Co. (Ltd.) remained closed during the entire year owing to market, labor, and transportation difficulties.

Foothill district.—The total production in the Foothill district, including that of 1920, has been about 155,045,000 pounds of copper.

Copper produced in Foothill district, Calif., 1916–1920.

Year.	Quantity.	Average yield.
	Pounds.	*Per cent.*
1916	6,460,000	3.07
1917	8,000,000	4.18
1918	6,937,000	2.07
1919	2,048,000	1.69
1920	2,201,000	.57

Plumas district.—The production of copper in the Plumas district in 1920 was 9,579,000 pounds, as compared with 10,860,000 pounds in 1919. The Engels Copper Mining Co. is by far the largest producer in the district, with an output in 1920 of 8,571,569 pounds of copper, 119,165.39 ounces of silver, and 1,217.867 ounces of gold.

Cost of producing copper by Engels Copper Mining Co., 1920.

		Total.	Cost per pound of copper.
			Cents.
Ore on cars at Engels		$1,077,837.93	12.57
Freight and smelting charges	$496,407.62		
Credit value of gold and silver recovered	145,266.07		
		351,141.55	4.10
Operating and marketing cost		1,428,979.48	16.67
Cost of depreciation and insurance		111,851.64	1.30
Net cost		1,540,831.12	17.97

All exploration and development work, with the exception of that absolutely necessary for the proper continuance of stoping operations, was discontinued early in October, 1920, because of the low selling price of copper.

Operations at Superior mill, 1920.

Ore milled	short tons	239,612
Average heads	per cent	2.21
Average tails	do	0.4514
Concentrates produced	pounds	29,039,970
Average content of concentrates	per cent	29.76
Copper produced	pounds	8,571,569
Silver produced	ounces	119,165.39
Gold produced	do	1,217.867

Ore reserves of Engels and Superior mines, December 31, 1920, in short tons.

Engels mine.		
Blocked ore.		
In place	1,075,807	
Broken ore in stopes	273,554	
		1,349,361
Probable ore		350,000
		1,699,361
Superior mine.		
Blocked ore:		
In place	363,000	
Broken ore in stopes	108,929	
		471,929
Probable ore		100,000
		571,929
Grand total		2,271,290

This estimate, according to the company's report, includes ore in pillars but does not include ore indicated by diamond-drill holes outside of the present stope area. Ore has been proved to exist by diamond-drill holes to a depth of 475 feet below the deepest developed ore on No. 7 level.

COLORADO.

In 1920 Colorado produced 4,282,616 pounds of blister copper, compared with 4,892,558 pounds in 1919. Although the State has no important producing district in which copper is the principal metal, it ranked tenth among the copper-producing States in 1920. The total recorded output for the State since 1845 is 284,012,588 pounds, or 0.96 per cent of the total for the United States.

The copper has been derived mainly from the treatment of mixed ores in which copper was a minor constituent, including lead-silver ores and pyritic ores rich in gold and silver. Leadville and the San Juan-Ouray region have been the greatest producers of copper. Much of the output is recovered as matte in lead furnaces.

IDAHO.

During 1920 Idaho produced 1,922,116 pounds of blister copper, compared with 3,966,655 pounds in 1919. To the end of 1920 it had a recorded output of 112,478,992 pounds.

There has been intermittent production from the Alder Creek or MacKay district since 1900. In 1920 the mines of the district produced 1,499,000 pounds of copper. The largest producer was the Empire Copper Co.

No new information is available regarding copper in the Coeur d'Alene region and other districts in Idaho.

MICHIGAN.

The total production of refined copper in Michigan, inclusive of 1920, is 6,860,460,103 pounds, and the production in 1920 was 153,483,952 pounds. The principal producing companies in the Lake Superior district are the Calumet & Hecla Mining Co. and its associated companies (the Ahmeek Mining Co., Isle Royale Copper Co., and Osceola Consolidated Mining Co.), the Copper Range Co. and its subsidiaries

(the Baltic Mining Co., Champion Copper Co., and Tri-Mountain Mining Co.), the Mohawk Mining Co., the Quincy Mining Co., and the Wolverine Mining Co.

The district had much the same experience as other copper districts of the United States in 1920, though perhaps the results were more severe.

Copper produced in Lake Superior district, Mich., 1916–1920.

Year.	Quantity.	Yield of copper.
	Short tons.	*Per cent.*
1916	12,364,114	1.08
1917	12,400,723	.99
1918	11,321,365	.96
1919	7,690,253	1.16
1920	5,938,967	1.30

Ore milled and copper derived therefrom by Michigan companies in 1917–1920.

[Compiled from the annual reports of the producing companies.]

Company.	1917		1918		1919		1920	
	Quantity.	Yield per ton.	Quantity.	Yield per ton.	Quantity.	Yield per ton.	Quantity.	Yield per ton.
	Short tons.	*Pounds.*	*Short tons.*	*Pounds.*	*Short tons.*	*Pounds.*	*Short tons.*	*Pounds*
Ahmeek	1,271,275	22.0	1,196,541	20.8	756,870	22.80	822,192	24.9
Allouez	566,674	15.69	514,888	13.73	235,312	15.94	131,643	18.98
Baltic	325,342	34.47	293,601	34.44	235,832	33.35	175,357	37.71
Calumet & Hecla	3,159,370	21.65	2,876,392	20.42	1,830,760	23.91	1,560,240	27.87
Centennial	148,332	13.50	159,040	15.67	87,688	15.57	41,418	13.55
Champion	776,036	35.50	594,235	36.599	503,030	39.053	321,664	42.419
Franklin	303,625	.....	273,964	.....	109,565	.....	.....	.....
Hancock	302,725	13.22	227,049	13.40	.....	.....	.....	.....
Houghton	15,628	11.45	.....	.....	.....	.....	.....	.....
Isle Royale	922,160	14.6	974,508	15.9	724,667	17.95	591,971	17.94
Keweenaw	41,148	9.248	.....	.....	.....	.....	.....	.....
La Salle	185,014	10.38	176,423	10.388	32,995	10.326	3,430	17.41
Mass	244,671	16.29	196,456	17.33	123,780	15.86	.....	.....
Michigan	2,091	.....	40,865	28.81	62,373	27.21	46,289	23.23
Mohawk	605,202	20.35	454,293	23.73	560,734	22.93	434,988	23.61
New Arcadian	4,900	.....	10,195	16.0	.....	.....	.....	.....
Osceola	1,237,805	13.0	1,194,967	13.3	739,364	14.60	455,982	16.37
Quincy	1,280,837	17.33	1,174,147	16.99	960,393	20.28	809,263	23.75
South Lake	[a] 68,388	11.03	7,694	28.09	.....	.....	.....	.....
Superior	129,587	16.99	106,213	15.78	27,267	20.68	9,549	33.81
Trimountain	264,655	23.72	201,433	26.52	171,995	30.66	116,768	30.24
Victoria	137,286	.....	106,730	14.37	89,206	14.00	61,031	16.50
White Pine	212,889	19.11	194,568	16.83	84,008	23.56	93,260	19.85
Winona	112,082	13.33	57,837	14.157	39,654	14.153	.....	.....
Wolverine [b]	352,845	16.60	303,498	15.185	298,089	15.306	257,294	15.282

[a] Includes from May, 1916, to Dec. 31, 1917. [b] Figures cover fiscal year ending June 30.

Because of the lessened demand for copper, the low price, and the high cost of production, the Calumet & Hecla, Ahmeek, and Isle Royale companies continued to operate on a greatly reduced basis, and the Allouez, Centennial, Osceola, and White Pine companies suspended operations entirely during 1920. Owing to the scarcity of labor, wages were not reduced until November 16. Development work was carried on by most of the companies in 1920.

According to the Copper Range Co.'s annual report, operations were carried on in 1920 at a profit during the first nine months, when copper sold for 18 and 19 cents, and the earnings of the company were sufficient to pay dividends of $591,625.50. Losses were incurred after September, however. The production of this company has declined steadily since the World War, and to a greater degree,

according to its report, than was general in the industry. The company has therefore been able to sell all of its output.

Operations were suspended by the Michigan Copper Mining Co. on October 1, 1920. The development work carried on by this company is reported to have been satisfactory.

The Mohawk Mining Co. operated throughout the year, but the average number of men in its employ was about 12 per cent less than that of 1919, or about 30 per cent less than normal.

The Quincy Mining Co., for the first time in more than 50 years, was unable to operate at a profit. It therefore continued active on a greatly reduced basis, with a view only to keeping the force together and the mine in condition to increase production when market conditions improved

The Seneca Copper Corporation sunk its No. 1 shaft 392 feet in 1920, making a total depth at the end of the year of 2,416 feet. Drifting was continued for a distance of 1,064 feet to the mining barrier between the Gratiot and the Mohawk, and the company reports that ore of good grade was proved for practically the entire distance. Mill tests made on 446.05 tons of ore from the stock pile produced 33,704 pounds of copper, or 75.56 pounds per ton of ore stamped, which equals 26.54 pounds of copper per ton of rock hoisted.

MONTANA.

By the end of 1920 Montana had furnished 27.06 per cent of the total output of the United States. Practically all of its output has been derived from the Butte district, which has produced 7,967,050,000 pounds of copper, or 26.91 per cent of the total domestic production. The district ranks first in the United States in total production and in production for 1920.

Copper and associated metals produced in Butte district, Mont., 1916–1920.

Year.	Copper.	Average yield in copper.	Gold.	Silver.
	Pounds.	*Per cent.*	*Ounce per ton.*	*Ounces. per ton.*
1916	349,500,000	2.81	0.0059	1.79
1917	270,500,000	2.81	.0056	1.84
1918	321,104,000	2.17	.0059	2.03
1919	169,051,000	2.16	.0071	2.69
1920	176,399,000	1.76	.0062	2.11

Copper, gold, and silver produced by Anaconda Copper Mining Co. from company ores, 1916–1920.

Year.	Ore treated.	Copper.	Silver.	Gold.	Dividends.
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*	
1916	5,273,066	307,395,092	10,790,705	92,099	$17,484,375
1917	3,906,901	239,014,880	8,368,180	58,545	19,815,625
1918	4,350,446	272,923,031	10,076,748	64,318	
1919	1,794,358	129,781,031	6,744,262	42,526	9,325,000
1920	1,828,380	138,763,065	6,420,026	32,530	6,993,750

Although the operations of the Anaconda Copper Mining Co. were continued at a greatly reduced rate in 1920, more development work was done than in 1919, and very satisfactory results were reported.

The annual report of the Anaconda Co. for 1920 states that

The mines of the company produced during the year 2,152,763.30 tons of ore and 7,557.11 tons of precipitates, a total of 2,160,320.41 tons.

The copper reduction works treated for all companies during the year 2,319,337 tons of ore and other cupriferous material at Anaconda. No copper ores were treated at Great Falls, except a small quantity of copper concentrates from Anaconda used for the fluxing of the zinc plant residue. Of the total quantity 1,828,380 tons of ore were produced by company mines, 458,339 tons of ore were either purchased from or treated for other companies, and 32,618 tons of precipitates and cleanings were from the old works at Anaconda and Butte.

At Anaconda there were produced 155,339,575 pounds of fine copper, 7,113,659.22 ounces of silver, and 32,530.302 ounces of gold.

Of this production, 138,763,065 pounds of fine copper, 6,420,026.20 ounces of silver, and 32,530.302 ounces of gold were produced for your company.

The electrolytic copper refinery at Great Falls produced during the year 145,149,892 pounds of cathodes which were melted into shapes at Great Falls.

The copper leaching plant at Anaconda treated during the year 484,353 tons of tailings and 43,272 tons of purchased ore, from which there were produced 5,037 tons of cement copper.

The copper concentrator also treated by flotation 181,034 tons of slimes from the ponds and 722,770 tons of tailings.

Copper, silver, and gold produced by North Butte Mining Co., 1916-1920.

Year.	Copper ore and precipitates treated.	Copper.	Silver.	Gold.	Dividends.
	Short tons.	*Pounds.*	*Ounces.*	*Ounces.*	
1916	544,456	24,498,181	1,047,063	1,712	$1,075,000
1917	296,773	14,493,452	662,845	959	1,075,000
1918	453,356	20,680,695	891,157	1,375	430,000
1919	287,800	14,331,254	633,215	914	.....
1920	315,233	16,666,819	693,633	1,004	.....

The average cost to the North Butte Mining Co. of producing copper for the year 1920 was 17.6378 cents a pound, including all expenses and depreciation, but not ore depletion, and deducting value of gold and silver.

Copper produced by East Butte Copper Mining Co., 1916–1920.

Year.	Ore mined.	Average copper content.	Copper produced by smelter.	Average cost per pound of copper.
	Short tons.	*Per cent.*	*Pounds.*	*Cents.*
1916	258,899	3.67	18,340,713	16.887
1917	189,473	4.31	20,013,900	17.672
1918	184,493	4.25	24,599,890	19.712
1919	146,542	3.71	19,987,733	16.582
1920	115,415	4.02	18,534,270	15.855

Operations of East Butte Copper Mining Co. for 1920.

Ore mined (wet weight)	short tons	115,415
Average assay value	per cent	4.02
Cost of mining per ton, including development		$7.15
Company ore treated (dry weight)	short tons	111,969
Customs ore treated (dry weight)	do	87,545
Total ore treated	do	199,514
Copper produced	pounds	18,534,270
Silver produced	ounces	690,488
Gold produced	do	867
Gross value of metals shipped		$3,241,812.96
Other income		70,746.51
Gross income from operations		3,312,559.47

Cost of mining, treatment, freight, selling, refining, and cost of custom ore purchased	$3,047,704.69	
Miscellaneous operations	4,621.52	
		$3,052,326.21
		260,233.26
Less depreciation	$44,397.90	
Ore depletion	7,199.10	
		51,597.00
		208,636.26
Less outside exploration		276,798.16
Net deficit on operations		68,161.90
Copper produced.....pounds		18,534,270
Price per pound received, New York.....cents		17.4560
Cost of production per pound delivered New York..do		15.8545
Profit per pound.....do		1.6015
Average price per ounce received for silver, New York, cents		99.625
Price per ounce received for gold, New York		$20.00

The total production for the year from all the properties of the Davis-Daly Copper Co. shows approximately 66 per cent more ore than during any previous year's operations.

Shipments and metallic contents of ore produced by Davis-Daly Copper Co., 1920.

	Ore hoisted.	Ore shipped.	Gold.	Silver.	Copper.
	Short tons.	*Short tons.*	*Ounces.*	*Ounces.*	*Pounds.*
Colorado Co., ore, copper	91,858	90,630		510,005.186	12,425,588
Colorado Co., precipitates	11	11			17,820
Colorado Co., lessees	9,229	9,229	22.442	29,003.736	1,212,656
Mount Moriah	71	71	4.887	601.582	
Great Republic	77	77	1.547	1,119.971	
Hibernian Co., ore	417	417	5.328	3,822.739	
Hibernian Co., lease ore	22,944	22,944	285.130	358,425.504	
	123,607	122,379	319.334	902,978.717	13,564,064

Operations of Tuolumne Copper Mining Co. at Main Range mine, 1918–1920.

Year.	Ore mined (wet).	Copper content.	Silver content.	Gold content.	Net smelter returns.
	Short tons.	*Per cent.*	*Ounces per ton.*	*Ounce per ton.*	
1918	25,405	2.253	8.082	0.0075	$248,220.63
1919	28,655	2.094	8.128	.0075	217,553.06
1920	30,521	2.0266	9.9497	.0075	265,332.33

NEVADA.

Nevada's production in 1920 was 55,580,322 pounds of copper, which represents 4.60 per cent of the total production in the United States. Inclusive of 1920 the total production in Nevada has been 942,379,318 pounds, which represents 3.18 per cent of the total production of the United States since 1845. Most of the production has come from two districts, the Ely and the Yerington, of which the former is by far the more important.

Ely district.—The Ely district, White Pine County, to the end of 1920 produced about 816,383,000 pounds of copper, or 2.76 per cent of the total output of the country. It produced 3.95 per cent of the output in 1920. In both total production and production for 1920 it ranked eighth among the copper districts of the country.

The Nevada Consolidated Copper Co. operated at approximately 50 per cent of capacity until the last quarter of 1920, when production was reduced to 40 per cent. An attempt was made to keep production at the same rate as sales, so that stocks at the end of the year were only slightly less than at the beginning.

Smelter production of metals in Ely (Robinson) district, Nev., 1916–1920.

Year.	Ore.	Copper produced.	Average yield in copper.	Gold and silver per ton of ore.
	Short tons.	*Pounds.*	*Per cent.*	*Cents.*
1916	4,053,526	93,037,587	1.14	20
1917	4,466,017	93,615,355	1.05	18
1918	4,519,445	92,396,638	1.02	24
1919	2,273,961	[a] 47,871,048	1.05	17
1920	2,589,546	[a] 48,347,828	.93	21

[a] Mine production.

Metals produced by Nevada Consolidated Copper Co., 1916–1920.

Year.	Ore treated.	Average assay of copper.	Average extraction of copper.	Gold and silver recovered per ton.	Refined copper produced.	Average cost of copper per pound.[a]	Dividends.
	Short tons.	*Per cent.*	*Per cent.*	*Cents.*	*Pounds.*	*Cents.*	
1916	3,922,634	1.632	73.87	20.44	90,735,287	10.17	$7,497,963
1917	4,064,095	1.462	73.08	.....	82,040,508	12.45	8,297,746
1918	3,999,526	1.506	69.95	.....	76,607,062	17.98	6,498,235
1919	2,135,425	1.599	70.49	.....	43,971,892	18.65	2,999,186
1920	2,568,588	1.449	70.20	.....	48,311,985	19.17	1,499,593

[a] Not applying usual credits for gold and silver and miscellaneous income.

Ore reserves of Nevada Consolidated Copper Co., Dec. 31, 1920.

	Ruth.		Eureka.		Total.	
	Quantity (short tons).	Per cent of copper.	Quantity (short tons).	Per cent of copper.	Quantity (short tons).	Per cent of copper.
Total ore developed to Dec. 31, 1919	15,689,768	2.220	82,700,457	1.468	98,390,225	1.580
Total ore milled to Dec. 31, 1920	4,484,096	1.952	30,060,498	1.553	34,544,594	1.605
Recoverable ore remaining Dec. 31, 1920	11,205,672	2.327	52,639,959	1.419	63,845,631	1.579

The reserves are exclusive of the carbonate ores mined and held in stock and of the ore partly blocked out in the Kimberly, Wedge, and Veteran groups. Developed ore in these groups aggregates about 800,000 tons of 2.4 per cent copper.

The property of the Consolidated Coppermines Co. was closed down during 1920, but a small production was made by the lessees.

Yerington district.—In the Yerington district the Mason Valley Mines Co. produced no copper in 1920, and development of the Mason Valley group of mines was discontinued late in April. A recalculation of the reserves of the Gray Eagle group shows the proved ore to be 1,045,000 tons containing 3.23 per cent of copper and 0.025 ounce of gold; and 500,000 tons containing 1.00 per cent of copper and 0.010 ounce gold.

Copper produced in Yerington district, Nev., 1916–1920.

	Pounds.		Pounds.
1916	3,491,000	1919	3,077,000
1917	19,396,000	1920	1,046,000
1918	17,139,000		

NEW MEXICO.

The production of blister copper from New Mexico in 1920 was 52,159,751 pounds, compared with 60,377,320 pounds in 1919. From 1845 to 1920 New Mexico had a recorded output of 698,126,486 pounds of copper, or 2.36 per cent of the total output of the country. The principal producing districts are those of Grant County.

Santa Rita district.—From the best sources available it is estimated that the total production of copper to the end of 1920 in the Santa Rita district has been 617,645,000 pounds.

Copper produced in Santa Rita district, N. Mex., 1916–1920.

	Pounds.		Pounds.
1916	74,228,000	1919	40,359,000
1917	82,200,000	1920	44,400,000
1918	77,547,000		

The Chino Copper Co. began producing late in 1911.

Metals produced by Chino Copper Co., N. Mex., 1916–1920.

Year.	Ore milled.	Copper content.	Mill recovery.	Production of refined copper.	Gold, silver, and miscellaneous income per pound.	Dividends.
	Short tons.	*Per cent.*	*Per cent.*	*Pounds.*	*Cents.*	
1916	3,094,400	1.83	66.59	72,319,508	0.260	$7,177,335
1917	3,608,100	1.64	69.32	79,636,235	.159	8,612,802
1918	3,836,400	1.63	63.275	75,655,641	.109	[a] 3,914,910
1919	1,765,200	1.82	65.67	40,488,706	.216	[b] 2,609,940
1920	1,838,140	1.76	70.67	44,051,849	.570	[c] 978,728

[a] $1,087,475 represents distribution of capital.
[b] Total represents distribution of capital, no dividends paid during 1919.
[c] $652,485 represents distribution of capital.

A recalculation of reserves made by the Chino Copper Co. gives fully developed unmined ore reserves of 103,811,623 tons, averaging 1.53 per cent of copper. In addition to the unmined ore, there are 1,789,159 tons, averaging 1.42 per cent of copper, in the stock piles

at Santa Rita and 88,465 tons in a special reserve used for experimental purposes, averaging 1.37 per cent of copper. This makes a total, of ore unmined and untreated at the end of 1920, of 105,689,247 tons, containing approximately 1.53 per cent of copper.

It is interesting to note that the ratio of the cost of labor per ton of ore milled in 1920 by the Chino Copper Co., compared with 1915, is 1.429 to 1, of supplies 2.783 to 1, and of all costs calculated on the same basis [including labor, supplies, administration, depreciation, and taxes (except Federal taxes)] 2.115 to 1. The operations of this company were carried on during the first part of the year at approximately 50 per cent of capacity, the rate being increased slightly in the second quarter of the year to meet the increased demand. When this demand was found to be temporary, however, operations were reduced again to 50 per cent and, toward the end of the year, to approximately 40 per cent.

Burro Mountain district.—The Burro Mountain district, southwest of Silver City, produced about 6,606,000 pounds of copper in 1920. The total production from the district has probably been about 64,173,000 pounds.

The net production from the mines of the Burro Mountain Copper Co. was 6,509,128 pounds of copper and 22,366 ounces of silver.

Metals produced by Burro Mountain Copper Co., N. Mex., 1920.

	Quantity (dry weight).	Per cent of copper.	Copper produced.	Silver produced.
	Short tons.		*Pounds.*	*Ounces.*
Concentrates	25,669	13.182	6,480,384	22,365.63
Leased ore	188	8.480	28,744	
	25,857	13.148	6,509,128	22,365.63

Operations of the concentrator of the Burro Mountain Copper Co., N. Mex., 1920.

Ore milled	short tons	231,152
Average assay	per cent of copper	2.043
Concentrates produced	short tons	25,669
Average assay	per cent of copper	13.182
Tailings produced	short tons	205,569
Average assay	per cent of copper	.632
Saving (average of four methods of figuring)	per cent	72.241
Ratio of concentration		9.005
Ore milled per day, actual running time	short tons	1,730.56
Kilowatt hours per ton of ore milled		15.28

Lordsburg district.—The Lordsburg district, in central Grant County, has been a steady producer of copper for several years.

Copper produced in Lordsburg district, N. Mex., 1916–1920.

[Mine figures.]

	Pounds.		Pounds.
1916	4,755,000	1919	3,516,000
1917	4,262,000	1920	2,696,000
1918	2,215,000		

TENNESSEE.

The production of blister copper in Tennessee in 1920 was 16,727,803 pounds, compared with 15,629,454 pounds in 1919.

The entire output came from the Ducktown district, in the extreme southeastern part of the State, in Polk County. To the end of 1920 the total output of this district has been 383,469,000 pounds.

Metals produced in Ducktown district, Tenn., 1916–1920.

[Smelter figures.]

Year.	Ore treated.	Copper produced.	Average yield of copper.	Gold and silver per ton of ore.
	Short tons.	*Pounds.*	*Per cent.*	*Cents.*
1916	482,495	14,556,278	1.52	14
1917	589,004	16,093,757	1.37	15
1918	529,012	15,053,568	1.42	18
1919	555,018	15,629,454	1.41	21
1920	589,853	16,727,803	1.42	21

The fact that the ores can be extracted with little timbering, the cheap supply of coke and coal from Tennessee and West Virginia, and the comparatively low cost of labor have made it possible to mine and treat these low-grade ores at a profit.

The pyritic process of smelting is practiced successfully by both the Ducktown Sulphur, Copper & Iron Co. and the Tennessee Copper & Chemical Corporation. The successful operation of sulphuric acid plants by both companies has not only helped to solve the troublesome smelter-smoke problem but has added very materially to the revenue of the companies.

The companies of the district are limited in their output of copper by the fact that some sulphur fumes necessarily escape into the air, and the volume that may be permitted to escape is limited by order of the courts.

Copper and sulphuric acid produced by Tennessee Copper & Chemical Corporation, 1916–1920.

Year.	Ore smelted.	Copper.	Sulphuric acid 60° Baumé.	Cost of copper per pound.	Dividends.
	Short tons.	*Pounds.*	*Short tons.*	*Cents.*	
1916	385,188	9,404,295	181,637	14.36	$150,000
1917	457,902	10,547,708	262,857	14.90	.....
1918	402,071	9,819,838	283,092	18.526	392,817
1919	413,877	10,414,815	266,627	18.715	.....
1920	404,060	10,358,237	333,629	19.135	.....

Ore reserves of the Tennessee Copper & Chemical Corporation in the Burra Burra, London, and Polk County mines at the end of 1920 were estimated at 3,533,134 tons.

In July, 1920, the Ducktown Sulphur, Copper & Iron Co. reported reserves of assured ore in the Mary mine to be 1,350,000 tons, and the reasonably assured ore brought the total up to 3,000,000 tons of ore carrying 1.6 per cent of copper and 16 per cent of

sulphur. It is estimated that at least 10,000 tons of ore averaging more than 2.5 per cent of copper remains in the East Tennessee mine, 2,500,000 tons (and probably much more) in the Isabella mine, and 1,000,000 tons in the Cherokee mine.

UTAH.

The total smelter production of copper from Utah to the end of 1920 amounted to 2,362,731,002 pounds, or 7.98 per cent of the total domestic production since 1845. The smelter production in 1920 was 110,357,748 pounds. The State ranks fourth in total production and in production for 1920.

Bingham district.—Inclusive of 1920, the Bingham district has produced 2,037,080,000 pounds of copper, or 6.88 per cent of the total production of the country since 1845. In 1920 the mine production decreased to 110,670,000 pounds, or 9.04 per cent of the total production of the United States for the year. The district ranks fourth in total production and fifth in output for 1920.

Copper produced in Bingham district, Utah, 1916–1920.

[Mine figures.]

	Pounds.		Pounds.
1916	223,620,000	1919	116,697,000
1917	225,412,000	1920	110,670,000
1918	211,195,000		

The Utah Copper Co. is by far the largest producer in the district and in the State.

Metals produced by Utah Copper Co. from ore milled, 1916–1920.

Year.	Ore milled.	Copper content.	Mill recovery.	Copper.[a]	Gold and silver per pound of copper.	Net cost per pound of copper.[b]	Dividends.
	Short tons.	*Per cent.*	*Per cent.*	*Pounds.*	*Cents.*	*Cents.*	
1916	10,994,000	1.44	62.34	187,531,824	0.65	6.92	$19,493,880
1917	12,542,000	1.337	61.10	195,837,111	.70	10.95	[c] 23,555,105
1918	12,160,700	1.226	65.11	188,092,405	.79	14.53	[d] 16,244,900
1919	5,538,700	1.26	78.46	105,088,740	.83	12.366	[e] 9,746,940
1920	5,556,800	1.16	81.38	101,897,758	.81	13.145	[f] 9,746,940

[a] Net production, not copper content of concentrates.
[b] Value of precious metals and railway earnings deducted.
[c] Includes $2,842,857 capital distribution.
[d] Includes $3,655,102.50 capital distribution.
[e] Includes $7,797,552 capital distribution.
[f] Includes $7,403,997.35 capital distribution.

Cost of mining, milling, and concentrating copper ore by Utah Copper Co., 1916–1920.

Year.	Ore.	Cost per ton.			
		Mining.	Transportation.	Milling.	Total.
	Short tons.				
1916	10,994,000	$0.2781	$0.2792	$0.3782	$0.9355
1917	12,542,000	.4446	.2794	.6930	1.4170
1918	12,160,700	.5370	.2983	.9277	1.7630
1919	5,538,700	.4900	.3040	1.2062	2.0002
1920	5,556,800	.4823	.2591	1.2472	1.9886

During the greater part of 1920 the properties of the Utah Copper Co. were operated at 50 per cent of capacity, but operations were curtailed to about 40 per cent toward the end of the year. No attempt was made to add to the ore reserves, but routine development work incident to operations has proved some additional ore.

From previous calculations, after deduction of the ore mined during 1920, the total ore reserves, exclusive of the ore represented by the uncalculated developments, amounted at the end of the year to 364,130,800 tons averaging about 1.35 per cent of copper. Stripping operations were carried on throughout the year, and 2,938,299 cubic yards of cap rock was removed, which makes a total of 53,044,034 cubic yards since the development of the deposit was undertaken. The stripping operations until January 1, 1921, covered a total area of 261.68 acres, of which 146.34 acres was entirely stripped. During the year 5,556,800 tons of concentrating ore was mined by steam shovels, a total of 90,476,900 tons of ore, averaging 1.374 per cent of copper, since steam-shovel mining was begun. The cost of production of copper was increased approximately 1 cent a pound owing entirely to the higher costs on the items of labor, supplies, freight, and smelting and refining.

The net operating income plus depletion decreased from $4,689,872.15 in 1919 to $3,376,654.19 in 1920; this was exclusive of income derived from dividends on investments and other sources of income foreign to the actual mining operations of the company.

The Utah Consolidated Copper Co. is the next largest producer in the district, as shown by the following table:

Copper, gold, and silver produced by Utah Consolidated Mining Co., 1916–1920.

Year.	Ore.	Copper content.	Copper.[a]	Gold per ton.	Silver per ton.	Dividends.
	Short tons.	*Per cent.*	*Pounds.*	*Ounce.*	*Ounces.*	
1916	360,034	1.734	12,211,118	0.052	0.796	$1,125,000
1917	226,536	1.797	7,968,165	.050	.764	1,050,000
1918	221,651	2.03	8,476,197	.054	.82	450,000
1919	126,893	2.22	5,710,346	.07	1.27	.....
1920	57,747	2.457	3,187,492	.0525	1.33	.....

[a] Includes copper derived from lead ores.

Production was curtailed further during 1920, owing partly during the first three quarters of the year to shortage of labor. During the last quarter, on account of the greatly reduced price received for copper, shipments were suspended except for a small quantity of ore taken out from exploration and development work. A flotation mill with a capacity of 1,000 tons a day was built during the year at International, Utah, for the treatment of the company's low-grade ore.

The Bingham Mines Co. operated its Dalton and Lark group of mines during the year, with the results shown below:

Copper, lead, gold, and silver produced by the Bingham Mines Co. from the Dalton and Lark mines in 1920.

	Ore.		Copper.	Lead.	Gold.	Silver.
	Wet tons.	*Dry tons.*	*Pounds.*	*Pounds.*	*Ounces.*	*Ounces.*
Lead	1,257.54	1,194.909	28,662	311,289	337.848	8,491.83
Copper	15,627.696	15,112.175	450,580	.....	1,589.792	73,722.41
	16,885.236	16,307.084	479,242	311,289	1,927.640	82,214.24

The company reports that on account of the relatively high silver content of both the lead and the copper ores, it was deemed advisable to continue production at the expense of mine development, with the result that although earnings were comparatively large, the reserves of ore that can be profitably exploited under present operating conditions were greatly diminished.

Tintic district.—The production of copper from the Tintic district is largely incidental to the production of other metals. The quantity of ore in which copper is the most valuable metal is very small. It is estimated that inclusive of 1920 the district has made a total production of 152,779,000 pounds of blister copper.

Copper produced in Tintic district, Utah, 1916–1920.

[Mine figures.]

	Pounds.		Pounds.
1916	7,107,000	1919	3,251,000
1917	9,118,000	1920	3,003,000
1918	6,569,000		

Beaver district.—Inclusive of 1920 the Beaver district has yielded about 49,123,000 pounds of copper.

Copper produced in Beaver County, Utah, 1916–1920.

[Mine figures.]

	Pounds.		Pounds.
1916	3,204,000	1919	539,000
1917	3,702,000	1920	47,000
1918	2,636,000		

OTHER STATES.

Georgia.—In 1920 Georgia produced 3,663 pounds of copper, as compared with 8,306 pounds in 1919. The productive area is adjacent to the Ducktown copper district, Tenn.

Oregon.—Oregon produced 2,529,311 pounds of blister copper in 1920, compared with 2,808,017 pounds in 1919. To the end of 1920 the State has a recorded output of 15,274,960 pounds of copper.

Washington.—In 1920 Washington produced 2,125,586 pounds of blister copper, as compared with 2,552,134 pounds in 1919.

Wyoming.—The production from Wyoming amounted to only 24,256 pounds of blister copper in 1920, as compared with 150,051 pounds in 1919.

REFINERY PRODUCTION.

The refinery output of copper in the United States in 1920 was made by 12 plants, 9 of which employed the electrolytic method and 4 employed the furnace process on Lake Superior copper, the Calumet & Hecla plant employing both methods. Six of the large electrolytic refineries are on the Atlantic tidewater and the four Lake refineries are on the Great Lakes; only two plants are located west of the Great Lakes—one at Great Falls, Mont., and one at Tacoma, Wash. In addition to these refineries there are numerous plants in different parts of the country that make a considerable output from old copper, brass, and other alloys of copper. The output of the regular refining plants is in the form of casting, Lake, and electrolytic copper.

CASTING AND PIG COPPER.

Blister copper that is low in precious metals and sufficiently free from impurities for certain uses is refined by the furnace process and ordinarily cast into ingots. This copper is usually unfit for uses requiring a high-grade copper, such as electric transmission, brass manufacture, and rolling, but is suitable for copper castings, and a large part of it is put to that use. Lake copper excepted, a comparatively small percentage of the copper output carries so small a content of precious metals that, together with the added value of electrolytic copper, it will not more than pay for the electrolytic refining of the copper; consequently the output of casting copper is small. Some blister or pig copper low in precious metals has been exported without further treatment and is probably consumed without electrolytic refining. A large percentage of the pig and casting copper shown in the table is from Arizona. Some of the districts produce a rather high grade of blister copper carrying a small amount of precious metals, and it is found profitable to market some of it without electrolytic refining. During 1920 the production of furnace-refined new casting copper amounted to 13,905,114 pounds and of unrefined pig and best select copper to 4,793,307 pounds.

LAKE COPPER.

By Lake copper, as the term is used in this report, is meant the output of the Lake smelters. A considerable portion of this output is refined electrolytically, but most of the electrolytically refined Lake copper is mixed with furnace-refined copper or is sold as some brand of Lake copper. Of the 153,483,952 pounds of copper produced by the Lake smelters, about 39,000,000 pounds was refined electrolytically, either to free the copper from impurities or to recover the silver content.

ELECTROLYTIC COPPER.

Under electrolytic copper, in the table below, is included all new copper that was refined electrolytically, except that from the Lake district that was marketed as Lake copper. In 1920 the production of electrolytic copper from primary materials of domestic origin amounted to approximately 1,010,241,000 pounds, and from materials of foreign origin to 450,195,000 pounds, and in addition 32,856,000 pounds was produced from secondary sources—a total of electrolytic production of 1,493,292,000 pounds for the year.

REFINED COPPER.

The total output of new refined copper in 1920 was 1,635,000,000 pounds, a decrease of 170,000,000 pounds from that of 1919.

Primary and secondary copper produced by regular refining plants and imported in 1916–1920, in pounds.

	1916	1917	1918	1919	1920
Primary:					
Domestic: [a]					
Electrolytic	1,579,620,513	1,452,744,593	1,560,327,422	1,233,994,324	1,010,240,867
Lake	269,794,531	268,508,091	231,096,158	177,594,135	153,483,952
Casting	12,469,050	69,916,911	15,284,635	18,223,145	13,905,114
Pig and best select	26,868,105	82,376,576	76,165,976	3,674,191	4,793,307
	1,888,752,199	1,873,546,171	1,882,874,191	1,433,485,795	1,182,423,240
Foreign: [a]					
Electrolytic	370,635,116	[b] 555,000,000	[b] 492,181,364	[b] 370,558,779	[b] 450,194,958
Casting and best select	.....	.....	57,329,735	1,262,227	2,290,446
	2,259,387,315	2,428,546,171	2,432,385,290	1,805,306,801	1,634,908,644
Secondary:					
Electrolytic	78,585,296	66,337,771	34,674,062	32,408,548	32,856,549
Casting	25,838,511	12,779,125	9,018,049	38,876,481	49,130,510
	104,423,807	79,116,896	43,692,111	71,285,029	81,987,059
Total output	2,363,811,122	2,507,663,067	2,476,077,401	1,876,591,830	1,716,895,703

[a] The separation of refined copper into metal of domestic and of foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.
[b] Includes refined copper imported.

If the output of plants treating purely secondary material is added to the production of the regular refining companies, the contribution from plants in the United States to the world's supply of copper for 1920 is found to be 2,260,000,000 pounds.

SECONDARY COPPER.

Under secondary copper is considered material recovered from remelting old copper, copper scraps, and copper recovered from the treatment of copper alloys or alloys that are treated without the separation of the copper. A canvass of plants producing secondary copper has been made by J. P. Dunlop, of the United States Geological Survey[4], and the following figures are taken from his report.

[4] Dunlop, J. P., Secondary metals: U. S. Geol. Survey Mineral Resources, 1920, pt. 1, p. 104, 1921.

Secondary copper, 1920.

	Short tons.
Copper as metal	97,000
Copper in alloys other than brass	33,600
	130,600
From new scrap	45,500
From old scrap	85,100
	130,600
Brass scrap melted:	
New clean scrap	140,000
Old scrap	119,800
	259,800
Copper content of brass scrap (averaging about 70 per cent copper):	Short tons.
New scrap	98,000
Old scrap	83,860
	181,860
Total copper produced from secondary sources:	
From new scrap	143,500
From old scrap	168,960
	312,460
Imports of scrap brass	22,682
Imports of scrap copper	5,475
Exports of scrap brass	1,030
Exports of scrap copper	289

In addition to the secondary material treated by the regular refining companies, plants that treated secondary material exclusively produced a total of about 542,933,000 pounds of copper as copper and in brass and other alloys of copper, making a total production of 624,920,000 pounds from secondary sources. Of this total at least 287,000,000 pounds was produced by remelting clean scrap produced in the manufacture of copper and brass articles.

Refined copper from secondary sources produced in the United States, 1916–1920, in pounds.

1916	700,000,000	1919	574,380,000
1917	766,800,000	1920	624,920,000
1918	705,340,000		

COPPER SULPHATE.

The production of hydrous copper sulphate or bluestone by the copper refineries of the United States in 1920 was 29,330,463 pounds, having a copper content of 7,823,000 pounds, compared with 31,081,287 pounds, having a copper content of 7,883,000 pounds, in 1919.

STOCKS.

Stocks of copper January 1, 1916–1921, in pounds.

Year.	Refined copper.	Blister and material in process of refining.
1916	82,429,666	274,000,000
1917	128,055,229	424,000,000
1918	114,000,000	411,000,000
1919	180,000,000	562,600,000
1920	631,000,000	273,000,000
1921	659,000,000	465,000,000

IMPORTS.

The quantity of copper in unmanufactured form imported into the United States in 1920 was 485,670,691 pounds, according to the records of the Bureau of Foreign and Domestic Commerce. The imports in 1919 were 429,387,594 pounds.

Copper imported into the United States in 1919 and 1920, by countries, in pounds.

[General imports.]

Country.	Ore (copper content).	Concentrates (copper content).	Matte and regulus (copper content).	Unrefined black copper and copper in bars, pigs, or other forms.	Refined in bars, plates, rods, or other forms.	Old and clippings for remanufacture.	Composition metal, copper chief value.
1919.							
United Kingdom	.....	.....	201,706	228,083	224,000	.....	223,689
Spain	2,157,072	.....	.....	.....	.....	2,000	.....
Canada	24,487,478	1,608,378	2,105,357	31,199,467	1,860,609	3,612,020	22,412
Mexico	918,091	27,600,065	28,852,151	52,609,210	12,467,393	6,954	.....
Chile	7,636,963	1,456,571	6,407,432	89,859,898	20,449,718	.....	.....
Cuba	11,107,064	3,947,226	925,295	363	.....	362,898	11,061
Peru	1,165,768	.....	304,530	80,829,505	.....	16,799	.....
Japan	.....	.....	.....	600	.....	.....	.....
Other countries	2,244,075	1,800,840	1,529,001	8,493,323	137,040	216,669	98,820
	49,716,511	36,413,080	40,325,472	263,220,449	35,138,760	4,217,340	355,982
1920.							
United Kingdom	1,256,948	.....	71,982	5,939,811	1,437,027	4,830,953	2,148,843
France	41,842	.....	76,109	3,073,425	3,258,043	4,822,375	54,092
Germany	.....	.....	617,940	130,957	60	806,041	566,625
Spain	2,123,594	.....	.....	.....	1,194,975	.....	.....
Canada	22,022,211	2,922,633	3,611,518	26,287,350	750,916	883,614	132,255
Mexico	883,716	25,931,336	7,361,140	72,670,790	.....	5,648	.....
Cuba	7,786,690	10,659,959	.....	.....	.....	61,387	.....
Chile	9,668,396	4,559,655	4,282,856	46,289,793	101,000,138	6,722	23,850
Peru	1,064,501	148,401	863,328	82,509,806	.....	.....	.....
Japan	.....	.....	.....	.....	.....	.....	.....
Other countries	7,197,393	2,575,606	709,301	7,794,392	1,102,139	141,627	1,309,982
	52,045,291	46,797,590	17,594,174	244,696,324	108,743,298	11,558,367	4,235,647

Copper (in unmanufactured form) imported into the United States, 1916–1920.

[General imports.]

	Pounds.		Pounds.
1916	462,335,980	1919	429,387,594
1917	556,420,297	1920	485,670,691
1918	575,805,115		

EXPORTS.

The exports of metallic copper (exclusive of ore, concentrates, and composition metal) from the United States in 1920 amounted to 623,158,489 pounds, according to the Bureau of Foreign and Domestic Commerce.

Copper exported from the United States, 1916–1920.

Year.	Quantity (pounds).		Total value.
	Metallic.[a]	Total.	
1916	784,006,486	789,791,254	$206,163,241
1917	1,125,647,336	1,132,832,663	338,723,756
1918	744,243,481	747,689,580	195,840,637
1919	515,595,019	516,627,775	117,417,055
1920	623,158,489	624,053,701	127,468,606

[a] Exclusive of ore, concentrates, and composition metal.

Copper sulphate (blue vitriol) exported from the United States, 1916–1920.

Year.	Quantity (pounds).	Value.
1916	19,469,565	$2,803,833
1917	29,068,748	3,038,380
1918	14,477,339	1,395,946
1919	9,140,673	928,291
1920	3,783,409	306,899

Copper exported from the United States, 1919–20, by kind and destination, in pounds.

1919.

Destination.	Ore (copper content).	Concentrates, matte and regulus (copper content).	Unrefined black copper and copper in bars, pigs, or other forms.	Refined, in bars, plates, rods, or other forms.	Composition metal, copper chief value.	Old and scrap.	Pipes and tubes.	Plates and sheets.	Wire (except insulated).	Total.
United Kingdom			1,347,600	105,619,710	68,120	157,583	33,552	4,285,424	4,587,562	116,099,551
Belgium				7,887,182				224,160	189,886	8,301,228
Denmark				8,520,252			44,774	64,354	963,063	9,592,443
France	250,880			89,188,652			386,564	456,355	1,505,510	91,787,961
Germany				6,831,400						6,831,400
Italy				65,343,538				1,174,289	9,155,242	75,673,069
Netherlands			49,660	14,981,725	1,156		844,945	618,100	5,911,342	22,406,928
Norway			223,948	3,568,709			419,691	270,791	15,512,542	19,995,681
Switzerland				11,854,687	3,919		1,500	133,896	3,548,607	15,542,609
Other Europe				35,617,023			433,969	642,323	5,679,445	42,372,760
Canada	256,966	160,821	45,368	19,781,227	39,318	125,692	537,196	1,798,426	1,157,713	23,902,727
Japan				65,595,603	200	738	1,524	138	46,444	65,644,647
Other countries			7,835	3,371,110	251,376	165,791	3,290,244	4,096,169	7,294,246	18,476,771
	507,846	160,821	1,674,411	438,160,818	364,089	449,804	5,993,959	13,764,425	55,551,602	516,627,775

1920.

United Kingdom			1,523,080	99,479,801	168,587		1,751	501,495	8,955,431	110,630,145
Belgium				28,090,450				131,062	105,975	28,327,487
Denmark				7,622,661			130	2,820	1,893,959	9,519,570
France			32,906	118,489,043			81	112,000	79,126	118,713,156
Germany				89,194,588					1,905,967	91,100,555
Italy				918,802	38,546		173,510	150,432	1,201,570	2,482,860
Netherlands				34,228,046			113,156	74,728	8,213,227	42,629,157
Norway				2,145,297		22,158	59,644	132,142	5,235,163	7,594,404
Switzerland				1,232,063				50,029	70	1,282,162
Other Europe				40,854,975			33,304	80,846	4,269,235	45,238,360
Canada	248,320	25,000	172,790	29,697,098	30,758	539,063	743,989	1,868,376	600,202	33,925,596
Japan	392			82,913,730			12,902	625	75,012	83,002,661
Other countries		167,194	114,517	16,360,239	216,415	16,098	3,760,756	19,694,593	9 277,776	49,607,588
	248,712	192,194	1,843,293	551,226,793	454,306	577,319	4,899,223	22,799,148	41,812,713	624,053,701

Brass exported from the United States in 1919–20.

	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Brass:	*Pounds.*		*Pounds.*	
Scrap and old	1,321,767	$176,028	2,060,468	$254,189
Bars, plates, and sheets	7,770,671	2,310,561	5,810,733	1,671,608
Cartridge shells, empty		169,961		122,193
Pipes and fittings		1,413,875		2,141,217
Wire	1,115,908	403,899	1,159,087	398,328
All other manufactures of		9,438,554		10,541,116
	10,208,346	13,912,878	9,030,288	15,128,651

Unmanufactured brass exported from the United States, 1917–1920.

Year.	Quantity (pounds).	Value.
1917	328,346,666	$101,521,426
1918	30,989,717	9,522,934
1919	7,770,671	2,310,561
1920	5,810,733	1,671,608

CONSUMPTION.

The refined new copper withdrawn from the total year's supply on domestic account in 1920 was 1,054,000,000 pounds; in 1919 it was 914,000,000 pounds. The method employed in determining the quantity of copper retained for consumption is shown in the following table, which does not include stocks of copper held by consumers:

New refined copper withdrawn from total year's supply on domestic account,[a] 1916–1920, in pounds.

	1916	1917	1918	1919	1920
Total supply of new copper	2,259,387,315	2,428,546,171	2,432,385,290	1,805,306,801	1,634,908,644
Stock at beginning of year	82,429,666	128,055,229	114,000,000	180,000,000	631,000,000
Total available supply	2,341,816,981	2,556,601,400	2,546,385,290	1,985,306,801	2,265,908,644
Copper exported [b]	734,879,881	1,047,771,685	704,715,714	439,835,229	553,070,086
Stock at end of year	128,055,229	114,000,000	180,000,000	631,000,000	659,000,000
Total withdrawn from supply	862,935,110	1,161,771,685	884,715,714	1,070,835,229	1,212,070,086
Withdrawn from total supply on domestic account	1,478,881,871	1,394,829,715	1,661,669,576	914,471,572	1,053,838,558

[a] Formerly called apparent consumption.
[b] Includes unrefined black blister and converter copper, in bars, pigs, or other forms, and refined copper in ingots, bars, rods, or other forms.

If to the 1,054,000,000 pounds of new refined copper is added the 625,000,000 pounds of secondary copper and copper in alloys produced during the year, it is found that a total of about 1,679,000,000 pounds of new and old copper was available for domestic consumption.

As may be seen from the method of calculation, the figures represent the quantity of new copper withdrawn from supply on domestic account but not actual domestic consumption, as they take no account of consumers' stocks. Furthermore, much of the copper exported is in manufactured forms; consequently much of the copper bought on domestic account during any year is exported in manufactured forms at a later date. As the records of the Bureau of Foreign and Domestic Commerce do not separate refined manufactured and unmanufactured copper, no close calculation of actual domestic consumption can be made.

USES.

There are no data available showing the quantity of copper that entered the different industries, and the great changes due to the war render any estimate more uncertain than usual.

The following table shows the copper cast in different forms in 1920. It will be noted that the total is not the same as the production of refined copper:

Copper cast in different forms in 1920.

Form.	Quantity (pounds).	Percentage.
Wire bars	841,000,000	52.53
Ingots	439,000,000	27.42
Cakes	205,000,000	12.80
Cathodes	39,000,000	2.44
Other forms	77,000,000	4.81
	1,601,000,000	100.00

PRICES.

The average price received for copper delivered by the producers in 1920 and the price used by the United States Geological Survey in calculating the value of the copper output was 18.4 cents a pound. The average received by selling agencies for 1,724,000,000 pounds, as reported to the Geological Survey by the agencies, was 18.433 cents a pound.

Average monthly quoted prices at New York per pound of electrolytic copper in 1916–1920, in cents, as reported by the American Metal Market Co.

Month.	1916	1917	1918	1919	1920
January	24.10	30.26	23.50	20.05	19.02
February	27.46	35.22	23.50	16.91	18.61
March	27.44	35.74	23.50	15.01	18.36
April	29.31	32.19	23.50	15.40	18.54
May	29.81	32.32	23.50	16.005	18.28
June	27.49	32.57	23.50	17.655	17.97
July	25.60	28.90	25.89	21.71	18.61
August	27.36	27.13	26.00	22.22	18.44
September	28.26	25.45	26.00	21.95	18.04
October	28.64	23.50	26.00	21.505	16.30
November	32.22	23.50	26.00	19.96	14.39
December	33.84	23.50	25.285	18.48	13.48
Average	28.46	29.19	24.68	18.905	17.50

Average monthly quoted prices at New York per pound of electrolytic copper in 1916–1920 as reported by the Engineering and Mining Journal.

Month.	1916	1917	1918	1919	1920
January	24.008	28.673	23.50	(a)	18.918
February	26.440	31.750	23.50	16.763	18.569
March	26.310	31.481	23.50	14.856	18.331
April	27.895	27.935	23.50	15.246	18.060
May	28.625	28.788	23.50	15.864	18.484
June	26.601	29.962	23.50	17.610	18.065
July	23.865	26.620	25.904	21.604	18.576
August	26.120	25.380	26.00	22.319	18.346
September	26.855	25.073	26.00	21.755	18.144
October	27.193	23.500	26.00	21.534	15.934
November	30.625	23.500	26.00	19.758	14.257
December	31.890	23.500	(a)	18.295	13.138
Average	27.202	27.180	24.628	18.691	17.456

a No market.

TIN.

By Bertrand Leroy Johnson.

PRODUCTION AND DEVELOPMENT.

The concentrates produced in tin-mining operations in the United States in 1920 were won from gravels mined in Alaska and from lode deposits in the Black Hills region of South Dakota.

Tin mined in the United States (including Alaska), 1915–1920, in short tons.

[Metallic tin estimated as obtainable from concentrates produced in tin-mining operations.]

1915	102	1918	69
1916	140	1919	56
1917	110	1920	22

ALASKA.[1]

Alaska produced 26 short tons of tin concentrate in 1920, 60 tons less than in 1919. The recoverable content of metallic tin of this concentrate is estimated to be 16 short tons. This decrease of output was due largely to the fact that in 1920 only one dredge instead of two, as in 1919, was operated in the tin-bearing placers of the York district of Seward Peninsula, which is the only important tin-producing area in Alaska. None of the tin mined in 1920 was marketed before the end of the year.

In the York district the American Tin Mining Co. operated its dredge on Buck Creek from July to October. Some open-cut mining was done with pick and shovel on Goodwin Creek. During the winter of 1919–20 about 20 men were employed in developing the Lost River tin mine, on Cassiterite Creek. A 250-foot incline was sunk on the tin-bearing dikes from a station on the lower tunnel. Work was suspended in May, 1920.

Though the only mines exploited solely for tin were the two in the York district, seven of the Yukon gold-placer mines reported the recovery of some stream tin, the metallic content of which is estimated at about 5½ short tons. Of these mines six were in the Hot Springs district and one in the Ruby district.

SOUTH DAKOTA.

The National Tin Corporation is reported to have mined and milled 800 tons of tin ore near Hill City, S. Dak., during the first eight months of 1920 and to have produced about 12 tons of concentrate. The

[1] Data regarding the Alaskan tin-mining industry are taken from Brooks, A. H., The Alaskan mining industry in 1920: U. S. Geol. Survey Bull. 722–A, pp. 22–23, 43, 46, 1921.

property was closed about September 1. Development work was done on the recently acquired Jackson Top Chief property, where a tunnel was driven 300 feet. A 50-foot tunnel was also driven on the Mowonotoc property. At the Tin Boom a shaft was sunk 100 feet on the ore body, 135 feet of drift was run, and a hoist was built and equipped with hoisting apparatus. A new and larger hoist was built at the Mohawk property. The mill of the corporation was equipped with much new machinery, and a smelter was constructed. From 50 to 60 miners and mill men were employed during the period of operation.

Only development work was done on the Frederic tin property, and only assessment work on the tin properties of the Rare Minerals Co. at Oreville.

NEW MEXICO.

Stream tin was discovered in the Taylor Creek district of New Mexico in 1918. The first locations were made in 1919 on Taylor Creek and later on Squaw Creek. In 1920 the limits of the district were extended by the discovery of tin-bearing lodes and placers on Hardcastle Creek. A complete description of the tin deposits of this district has recently been published.[2] Up to August, 1920, development work had been done only at Cave City, near the mouth of Taylor Creek, on Squaw Creek, on Hardcastle Creek, and near the McCarty ranch. The developments were confined to the more conspicuous deposits, and though they gave a fair idea of the general characteristics of the deposits, they had not at that time been extensive enough to prove that the deposits could be profitably worked. The gravels of Squaw Creek had been tested in a rather systematic manner, and tests of the gravels in other streams had shown the presence of tin. The testing of the gravels on Taylor Creek in the vicinity of Cave City had reached only to water level. In Nugget Gulch several shallow pits and open cuts had been dug in altered cassiterite-bearing rhyolite, and on Squaw Creek two short tunnels had been run in another tin-bearing area of rhyolite. A few openings have also been made in tin-bearing rhyolite areas on Beaver and Taylor creeks. On Taylor Creek the New Mexico Tin & Metals Co. was driving a tunnel which in August, 1920, had reached a length of 90 feet. A number of pits, open cuts, and shafts had also been sunk.

SMELTING INDUSTRY.

Six tin-smelting plants in operation in the United States produced 17,652 short tons of metallic tin. Practically the whole of the output was smelted from Bolivian concentrate. The largest output was made by the American Smelting & Refining Co. at its plant at Perth Amboy, N. J. Other producing concerns were the Williams Harvey Corporation, Jamaica Bay, Brooklyn, N. Y.; the Andes Electin Co., New York City; the Eastern Metal & Refining Co. (Inc.), Boston, Mass.; the Seaboard Metal Corporation, Arlington, N. J.; and the American Tin Smelteries (Inc.), Matawan, N. J. The changes from the preceding year are the discontinuance of tin-smelting opera-

[2] Hill, J. M., The Taylor Creek tin deposits, New Mexico: U. S. Geol. Survey Bull. 725–G, 1921. The notes as to developments are taken from Hill's report.

tions by the Norton Laboratories (Inc.), Lockport, N. Y., and the addition of the American Tin Smelteries (Inc.) as a producer. A smelter is reported to have been erected by the National Tin Corporation in 1920 in the Black Hills region of South Dakota, but it is not known to have been operated. The smelting of imported tin-bearing concentrate in this country was begun in 1916.

Smelter output of metallic tin in the United States, 1916–1920, in short tons.

1916	2,261	1919	12,236
1917	6,065	1920	17,652
1918	10,284		

IMPORTS AND EXPORTS.[3]

Tin concentrate imported into the United States, 1915–1920.

[General imports.]

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1915	552	$182,950	1918	18,394	$11,444,401
1916	8,040	4,032,460	1919	19,196	11,871,948
1917	9,054	4,743,099	1920	34,148	18,795,162

Tin imported as metal and entered for consumption in the United States, 1915–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1915	57,792	$38,736,909	1918	71,254	$93,144,218
1916	69,035	51,802,232	1919	44,849	50,890,019
1917	72,166	63,860,340	1920	62,795	73,440,872

The details of the general imports of tin concentrate and metallic tin for 1920 are given in the following table. The real origin of the concentrate and metal is not disclosed by this table, for it indicates only the countries from which the shipments were made direct to the United States. Many of the figures represent reexports.

[3] Statistics of imports and exports compiled from the records of the Bureau of Foreign and Domestic Commerce.

Tin concentrate and metallic tin imported into the United States in 1920.

[General imports.]

Country.	Tin concentrate.		Metallic tin as bars, blocks, grains, and granulated.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
France			111	$96,120
Netherlands			1,025	1,125,953
England	1,164	$541,579	12,122	13,128,295
Scotland			a 686	467
Canada	72	31,923	101	132,100
Costa Rica			17	17,589
Panama	3	1,231		
Mexico			a 140	84
Newfoundland			a 50	5
Argentina			270	315,452
Bolivia	16,665	8,814,084	39	35,598
Brazil			26	9,014
Chile	14,010	8,678,778	191	215,203
Ecuador	60	29,923		
Peru	2,174	697,212		
China			336	399,011
British India			137	159,341
Straits Settlements			38,806	47,328,560
Dutch East Indies			1,687	1,887,291
Hongkong		432	6,354	7,109,349
Japan			168	171,920
Australia			1,519	1,567,809
Philippine Islands			110	87,604
	34,148	18,795,162	63,019	73,786,765

a Pounds.

Exports of tin ore are insignificant and are not recorded. Domestic exports of metallic tin (imported as ore and exported as pigs, bars, etc.) amounted to 306 short tons in 1919 and 706 short tons in 1920. Foreign exports of metallic tin (imported as pigs, bars, etc., and exported as such) were 76 short tons in 1919 and 333 short tons in 1920.

CONSUMPTION.

The quantity of new (primary) tin made available for consumption in the United States during any given year may be obtained by adding the general imports of metallic tin to the quantity of tin produced in the United States and subtracting from the result the sum of the domestic and foreign exports of metallic tin. The following table gives this information for 1920:

New tin made available for consumption in the United States in 1920, in short tons.

Metallic tin imported into the United States (general imports)	63,019	
Tin produced by smelters in the United States from foreign ore	17,652	
		80,671
Domestic tin exported	706	
Foreign tin reexported	333	
		1,039
		79,632

The quantity of this new tin actually consumed in the United States during 1920 is not susceptible of accurate determination, a close estimate of this annual consumption not being possible without a knowledge of the stocks in various hands in this country, statistics for which are not at present collected by the Geological Survey.

PRICES.

The average price of Straits tin in New York in 1920 was 50.36 cents a pound, as compared with 65.54 cents in 1919.[4] The course of the market during the year is shown in the following table:

Average monthly prices, in cents per pound, of Straits tin in New York in 1920.[4]

January	62.89	May	55.07	September	44.62
February	60.00	June	48.62½	October	40.64
March	61.99	July	49.37½	November	37.02
April	62.20	August	47.69	December	34.15

The average price for the year in London was £296 1s. 7d. per ton of 2,240 pounds. The lowest price per ton was £195 and the highest price was £419½.[5]

[4] Metal Statistics, 1921, p. 355.
[5] Idem, p. 361.

GOLD AND SILVER.

(GENERAL REPORT.)

By J. P. DUNLOP.

PRODUCTION.

DOMESTIC PRODUCTION.

Approximate distribution, by producing States and Territories, of the production of gold and silver in the United States for 1920.

[Figures supplied by the U. S. Bureau of the Mint.]

State or Territory.	Gold.		Silver.	
	Quantity (fine ounces).	Value.[a]	Quantity (fine ounces).	Value.[b]
Alabama	10	$200	5	$5
Alaska	412,915	8,535,700	822,410	903,228
Arizona	240,032	4,961,900	5,431,637	5,965,404
California	716,477	14,810,900	1,654,653	1,817,256
Colorado	363,218	7,508,400	5,166,873	5,674,622
Georgia	34	700	4	4
Idaho	22,668	468,600	7,364,785	8,088,523
Illinois			8,625	9,473
Massachusetts	10	200	1,160	1,274
Michigan			511,664	561,945
Missouri	14	300	123,094	135,190
Montana	91,802	1,897,700	13,263,356	14,566,746
Nevada	175,451	3,626,900	7,481,866	8,217,109
New Mexico	21,720	449,000	699,745	768,509
North Carolina	54	1,100	10	11
Oregon	49,714	1,027,700	101,658	111,648
Pennsylvania			90	99
Philippine Islands	61,756	1,276,600	22,118	24,292
South Carolina	14	300	1	1
South Dakota	209,842	4,337,800	87,623	96,234
Tennessee	285	5,900	107,250	117,790
Texas	5	100	522,818	574,195
Utah	102,975	2,128,700	11,755,411	12,910,615
Washington	7,160	148,000	177,758	195,226
Wyoming	10	200	56,959	62,556
	2,476,166	51,186,900	55,361,573	60,801,955

[a] Gold value $20.67 per fine ounce.

[b] Valued at $1.09827 per ounce, the average of the New York prices, to the end of May, when the Pittman Act (of Apr. 23, 1918), became effective; thereafter at $1 per ounce, as provided by that act.

The figures in this table were obtained through cooperation between the United States Bureau of the Mint and the United States Geological Survey and were agreed upon after conference and adjustment between the two bureaus. They are therefore final for both.

The totals are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by means of information collected by the United States Geological Sur-

vey directly from the producing mines, and tabulated for the mines reports later discussed. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in United States mints and assay offices, (2) the domestic gold and silver in fine bars reported by private refineries, and (3) the unrefined domestic gold and silver contained in ores and matte exported for reduction. The last item is relatively small.

Increase or decrease in production of gold and silver in the United States in 1920.

State or Territory.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
Alabama	+ 10	+ $200	+ 5	+ $5
Alaska	− 69,069	−1,427,800	+ 132,259	+ 129,658
Arizona	+ 17,067	+ 352,800	− 271,274	− 426,818
California	− 125,161	−2,587,300	+ 501,039	+ 524,205
Colorado	− 132,592	−2,740,900	− 799,733	−1,013,168
Georgia			− 4	− 5
Idaho	− 11,417	− 236,000	+1,431,709	+1,438,316
Illinois			+ 2,625	+ 2,748
Maine	− 10	− 200	− 4,142	− 4,644
Massachusetts	+ 10	+ 200	+ 1,160	+ 1,231
Michigan			+ 86,054	+ 84,879
Missouri			+ 47,103	+ 50,014
Montana	− 25,116	− 519,200	−1,748,902	−2,260,044
Nevada	− 49,933	−1,032,200	+ 436,471	+ 320,132
New Mexico	− 6,599	− 136,400	− 152,073	− 186,274
North Carolina	+ 49	+ 1,000	− 9	− 10
Oregon	− 3,315	− 68,500	− 134,962	− 153,572
Pennsylvania			+ 90	+ 99
Philippine Islands	+ 20,637	+ 426,600	+ 6,403	+ 6,678
South Carolina	+ 9	+ 200	− 1	− 1
South Dakota	− 46,047	− 951,900	− 34,445	− 40,588
Tennessee	+ 14	+ 300	+ 9,696	+ 8,445
Texas	− 14	− 300	− 16,665	− 30,495
Utah	− 6,686	− 138,200	− 787,212	−1,148,035
Vermont	− 19	− 400	− 2,200	− 2,466
Virginia			− 8	− 9
Washington	− 4,276	− 88,400	− 80,512	− 94,261
Wyoming	− 4	− 100	+ 56,659	+ 62,220
	− 442,462	−9,146,500	−1,320,872	−2,731,697

Domestic smelters and refiners produced 628,426 fine ounces of gold and 57,808,511 fine ounces of silver from foreign ores and bullion, a decrease of 39,735 ounces of gold, but an increase of 2,388 ounces of silver compared with the corresponding figures for 1919. The foreign ores came mainly from Mexico, Canada, and Peru.

The value of the new gold used in the arts and industries in the United States in 1920 was $54,009,609, compared with $56,135,951 in 1919, and the quantity of silver used for such purposes was 19,280,129 fine ounces, compared with 26,237,519 ounces. The consumption of new silver in the arts and industries in 1920 was equal to 35 per cent of the domestic production and that of gold to 106 per cent of the domestic production. In addition to the gold and silver derived from foreign and domestic ores and bullion $28,205,478 of gold and 8,694,392 fine ounces of silver were recovered from old jewelry, dental waste, silverware, and other old material. The value of all the new and old gold used in the arts and industries in 1920 was more than $82,200,000, which exceeded the value of the domestic output from mines by more than $31,000,000.

PRICES OF SILVER.

The average official monthly prices of fine bar silver in New York in 1920 were as follows:

Prices of silver per fine ounce in 1920, by months.

January	$1.33899	Mean of the average New York bid and asked quotations on all silver.
February	1.32665	
March	1.27287	
April	1.20576	
May	1.03495	
June	.95878	Average price on above basis to June 16.
July	.995	Price for silver salable to the Director of the Mint under the terms of the Pittman Act (except for two days in August, when the market for all silver was above that point).
August	.99707	
September	.995	
October	.995	
November	.995	
December	.995	
	1.09251	Average price for silver from domestic mines in 1920.

Silver, to be salable to the Director of the Mint under the Pittman Act and mint regulations, must be of undoubted domestic production and reduction, and the benefit of the higher price must have been given to the owner of the producing mine.

Price of silver per fine ounce, 1865–1920.[1]

1865	$1.337	1884	$1.11	1903	$0.54
1866	1.339	1885	1.07	1904	.58
1867	1.33	1886	.99	1905	.61
1868	1.326	1887	.98	1906	.68
1869	1.325	1888	.94	1907	.66
1870	1.328	1889	.94	1908	.53
1871	1.325	1890	1.05	1909	.52
1872	1.322	1891	.99	1910	.54
1873	1.297	1892	.87	1911	.53
1874	1.278	1893	.78	1912	.615
1875	1.24	1894	.63	1913	.604
1876	1.16	1895	.65	1914	.553
1877	1.20	1896	.68	1915	.507
1878	1.15	1897	.60	1916	.658
1879	1.12	1898	.59	1917	.824
1880	1.15	1899	.60	1918	.980
1881	1.13	1900	.62	1919	1.12
1882	1.14	1901	.60	1920	1.09
1883	1.11	1902	.53		

PRODUCTION OF GOLD AND SILVER SINCE 1792.

Gold and silver produced in the United States, 1792–1920.

[The estimate for 1792–1372 is by R. W. Raymond, commissioner, and for the period since 1872 by the Director of the Mint.]

Period.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity. (fine ounces).	Commercial value.
1792–1847	1,186,977	$24,537,000	309,500	$404,500
1848–1872	58,279,781	1,204,750,000	118,568,200	157,749,900
1873–1920	138,526,065	2,863,587,900	2,440,513,896	1,927,680,036
	197,992,823	4,092,874,900	2,559,391,596	2,085,834,436

[1] Based on London price of bar silver 1.000 fine and taken at average price and par of exchange, 1865–1915; New York dealers' buying price for 1916–1919; average buying price of silver from domestic mines for 1920.

Although the output of gold was less than one-thirteenth the output of silver in quantity, its value was about twice that of the silver.

The average commercial value per fine ounce of silver for the 128 years contributing to the total domestic production was nearly $0.815. Fluctuations in value of silver per fine ounce are shown in the curve in figure 17. For the years shown (1871 to 1920, inclusive), the average annual value was more than $0.80 before 1893, and it has been less than that figure every year since until 1917, when it was $0.82; 1918, when it was $0.98; 1919, when it was $1.12; and 1920, when it was $1.09.

IMPORTS AND EXPORTS.

Value of gold and silver imported into and exported from the United States, 1919 and 1920.

1919.

	Imports.	Exports.	Excess of—	
			Imports.	Exports.
GOLD.				
Contained in domestic ore and base bullion		$20,719		$20,719
Contained in foreign ore and base bullion	$16,744,430		$16,744,430	
Domestic bullion refined		122,055,164		122,055,164
Foreign bullion refined	33,183,373		33,183,373	
United States coin	11,244,897	245,496,208		234,251,311
Foreign coin	15,361,346	613,157	14,748,189	
	76,534,046	368,185,248	64,675,992	356,327,194
Excess exports over imports				291,651,202
SILVER.				
Contained in domestic ore and base bullion		6,693		6,693
Contained in foreign ore and base bullion	74,073,332	1,252	74,072,080	
Domestic bullion refined		186,533,723		186,533,723
Foreign bullion refined	8,382,030	23,644,997		15,262,967
United States coin	1,057,135	21,224,827		20,167,692
Foreign coin	5,897,521	7,609,559		1,712,038
	89,410,018	239,021,051	74,072,080	223,683,113
Excess exports over imports				149,611,033

1920.

GOLD.				
Contained in domestic ore and base bullion		$11,260		$11,260
Contained in foreign ore and base bullion	$16,984,171		$16,984,171	
Domestic bullion refined	3,845,775	37,203,349		33,357,574
Foreign bullion refined	322,415,060	1,901,594	320,513,466	
United States coin	18,093,178	282,293,126		264,199,948
Foreign coin	55,730,089	681,879	55,048,210	
	417,068,273	322,091,208	392,545,847	297,568,782
Excess imports over exports			94,977,065	
SILVER.				
Contained in domestic ore and base bullion		16,522		16,522
Contained in foreign ore and base bullion	69,845,999	900	69,845,099	
Domestic bullion refined	3,053	4,349,365		4,346,312
Foreign bullion refined	7,871,083	89,961,684		82,090,601
United States coin	2,093,073	14,771,492		12,678,419
Foreign coin	8,246,833	4,516,261	3,730,572	
	88,060,041	113,616,224	73,575,671	99,131,854
Excess exports over imports				25,556,183

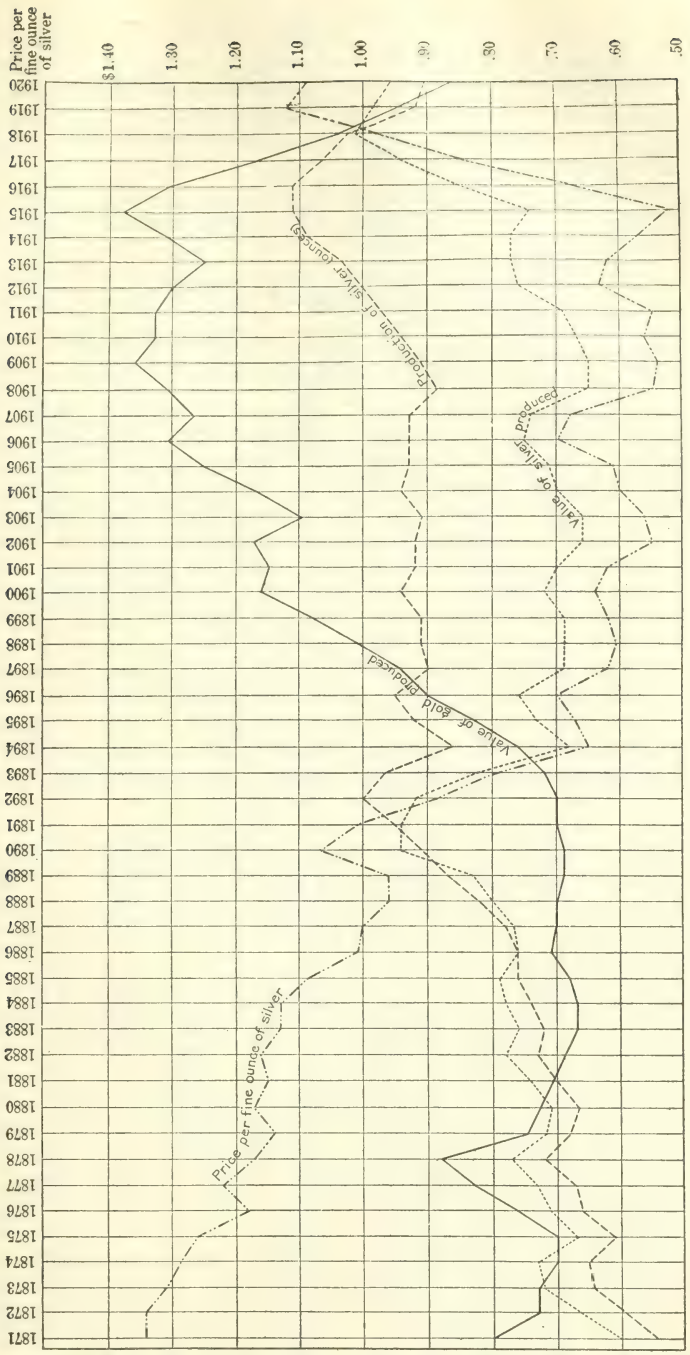


FIGURE 17.—Curves showing production and value of gold and silver and price per fine ounce of silver in the United States, 1871–1920.

DOMESTIC SUPPLY.

The remarkable gain in the domestic supply of gold indicated by the great excess of $530,200,000 in imports over exports in 1916, of $180,000,000 in 1917, and of $21,000,000 in 1918 had come to a halt in the early part of 1919, but was resumed in 1920 owing to large imports of foreign bullion and coin.

The value of the excess of exports of silver in 1920 was about $124,000,000 less than in 1919, owing to the large decrease in the shipments to China, Japan, and India.

The total number of silver dollars remelted under the Pittman Act was 270,232,722, which if all had been of exact legal weight would have contained 209,009,120.9 fine ounces of silver, but which yielded on remelting 208,622,056.8 fine ounces. The purchases of silver from domestic mines in 1920 at the price fixed under the Pittman Act were as follows, in fine ounces: May, 332,088; June, 6,168,505; July, 3,288,856; August, 3,429,277; September, 3,815,733; October, 4,634,860; November, 3,638,870; December, 4,599,172; total, 29,907,361. The purchases in May, the first month in which the fixed Mint price was higher than the open-market price, were comparatively small. The average monthly purchases for the remaining seven months of 1920 were about 4,220,000 fine ounces, which would be about 50,700,000 ounces a year. The purchases in 1921 by months were as follows, in fine ounces: January, 4,677,188; February, 4,615,842; March, 5,912,065; April, 4,334,741; May, 6,836,500; June, 4,442,000; July, 4,670,119; August, 4,913,614; September, 3,471,436; October, 5,917,997; November, 3,447,000; December, 5,424,025; total, 58,662,527. The total purchases to December 31, 1921, were 88,569,888 fine ounces, leaving about 120,052,000 fine ounces to be purchased under the Pittman Act in 1922 and succeeding years.

Resumption of mining at base-metal mines will increase the quantity of domestic silver, but it is impossible at present to predict when the total purchases will reach the total quantity of silver necessary to replace the silver dollars remelted. From present indications the period required will probably be slightly more than two years from January 1, 1922.

The domestic supply of new gold comes chiefly from dry or siliceous gold ores, treated mainly in gold mills by amalgamation or cyanidation or both and partly by smelting, and from placer gravels worked largely by dredges. As shown on page 534, these ores and placer gravels supplied more than 89 per cent of the yield of gold in 1920. Considerable gold is now recovered also from the refining of copper bullion from copper ores, especially in the West Mountain or Bingham district, Utah, and the Summit Valley or Butte district, Mont. In 1920 the copper ores of the United States produced 7.2 per cent of the total gold, against 6.8 per cent in 1919. The natural tendency has been for the proportionate output from gold ores to decrease with declining yield from some of the principal gold camps and for that from copper ores to increase, with a general net decline of total yield of gold owing to the preponderant output from gold and gold-silver ores. This tendency was suspended in 1919 owing to the large decrease in the output of copper.

The principal domestic supply of new silver came from dry or siliceous silver and silver-gold ores, copper ores, lead ores, and lead-zinc ores in the proportion of 36.22, 21.49, 30.19, 8.56 per cent, respectively, in 1920, against 36.69, 24.82, 27.65, 10.16, respectively, in 1919. The bulk of the dry and siliceous silver ores are milled and cyanided at or near the mines, although a small quantity of richer ore is shipped to copper and lead smelters. The silver obtained as by-product from copper, lead, and zinc ores is derived from refining the copper and lead bullion produced in smelting those and other ores.

WORLD'S PRODUCTION OF GOLD.

The value of the gold produced in the world in 1920 was $334,987,600, and the value from 1860 to 1920, inclusive, was $13,672,929,924.

In 1920 the estimated production of gold in the world decreased $30,801,000, following a decrease of about $38,500,000 in 1918 and of $15,136,000 in 1919. The production in the United States decreased about $9,146,000; Mexico, $411,000; Africa, $6,004,000; Australasia, $3,262,000; India, $1,458,000.

In the following table is shown the output of gold, by countries, as given by the Bureau of the Mint:

World's production of gold, 1916–1920.

Country.	1916	1917	1918	1919	1920
North America:					
United States	$92,590,300	$83,750,700	$68,646,700	$60,333,400	$51,186,900
Canada	19,235,000	15,273,000	14,687,900	15,850,400	15,853,500
Mexico	7,690,700	9,000,000	16,824,700	15,676,500	15,265,600
Africa	222,948,900	214,304,300	197,073,600	193,896,500	187,892,200
Australasia	40,475,800	34,398,100	29,268,600	26,911,500	23,649,000
Europe:					
Russia, Finland, and Siberia	22,500,000	18,000,000	12,000,000	11,000,000	1,447,000
Austria-Hungary	1,000,000	150,000	180,000	.....	.....
Sweden	12,200	10,000	10,000	10,000	10,000
Italy	2,000	700	22,800	15,300	15,000
France	1,000,000	700,000	500,000	151,000	151,000
Great Britain	5,700	5,000	.....	.....	.....
Greece	.....	.....	.....	4,600	4,000
Czechoslovakia	.....	.....	.....	125,600	181,000
South America:					
Argentina	15,300	4,600	4,000	4,000	3,000
Bolivia and Chile	301,000	770,700	770,000	770,000	705,000
Colombia	6,173,900	5,000,000	4,866,500	6,000,000	5,800,000
Ecuador	560,000	887,800	800,000	800,000	750,000
Brazil	2,890,000	2,958,000	2,800,000	2,000,000	1,800,000
Venezuela	1,269,900	636,900	473,200	600,000	500,000
Guiana—					
British	660,700	519,000	400,000	335,200	182,800
Dutch	438,200	445,000	322,200	329,300	300,000
French	1,600,000	1,438,500	1,100,000	1,100,000	900,000
Peru	1,267,400	1,254,100	1,250,000	1,348,400	1,297,300
Uruguay	12,000	10,000	10,000	10,000	8,000
Central America	3,517,600	3,122,000	3,400,000	3,300,000	3,000,000
Asia:					
Japan	5,185,600	4,679,700	5,105,900	4,824,900	5,518,000
China	3,100,700	3,600,100	3,600,000	3,300,000	3,000,000
Indo-China	65,600	50,000	50,000	40,000	40,000
Chosen (Korea)	4,122,400	3,363,800	3,300,000	2,800,000	3,000,000
India, British	11,206,500	10,812,800	10,028,000	10,486,000	9,027,800
East Indies, British	3,000,000	2,853,700	2,571,400	2,564,000	2,479,500
East Indies, Dutch					
Federated Malay States	327,900	342,400	345,300	339,000	265,700
Formosa	1,001,200	1,081,200	513,700	417,200	417,300
Sarawak	.....	.....	.....	446,000	338,000
	454,176,500	419,422,100	380,924,500	[a] 365,788,800	[b] 334,987,600

[a] Revised figures. [b] Revised figures will be given in the report for 1921.

Estimates have been made for the years from 1916 to 1920 for some foreign countries that produce comparatively small quantities of gold, because of the difficulty of obtaining accurate statistics since the beginning of the World War. For a few other countries, because of the lack of basis for estimates, the figures for preceding years have been repeated. The statistics were mainly adjusted in conference between the Mint and the Geological Survey.

The notable increase of total world's output of gold culminated in a record of $468,724,918 in 1915. Since 1915 there has been a steady yearly decrease, and the output in 1920 was $133,737,000 less than that of 1915.

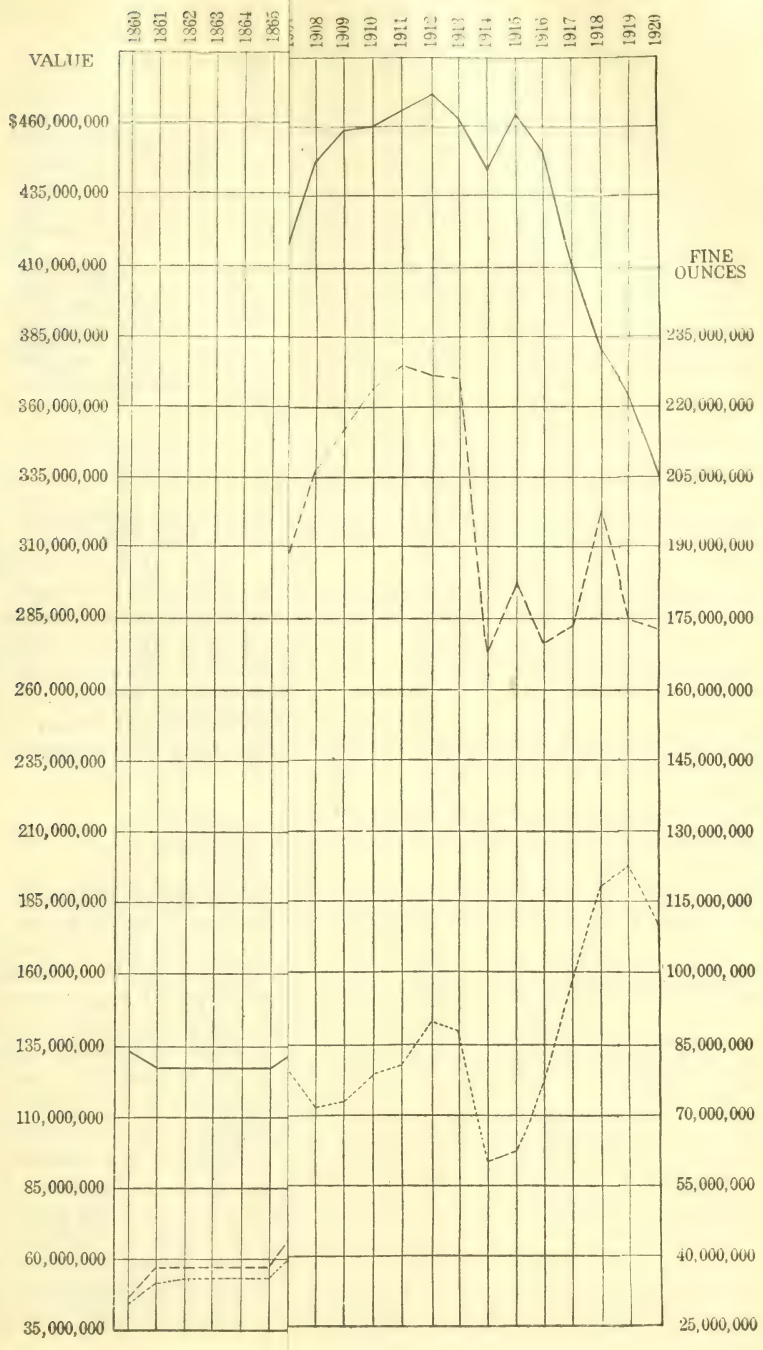
The present tendency, in the absence of discovery of new gold fields and development on a large scale, is toward a declining world's output of new gold; and this tendency is accentuated by the high cost of labor and supplies, which makes the operation of many gold mines unprofitable. In 1921 small increases in the production of Canada and some South American countries were more than offset by decreases in the United States, South Africa, and Australia.

WORLD'S PRODUCTION OF SILVER.

The figures for the world's production of silver in 1920 show that the United States and Canada produced about 39 per cent, against 41 per cent in 1919, and that Mexico, Central America, and South America produced nearly 48 per cent, so that approximately only 22,932,000 ounces of silver came from all other countries, mainly from Australia, Japan, Spain, and Burma. There was a small increase in the quantity of silver produced in Mexico in 1920, but the production from mines in the United States decreased about 1,320,000 ounces and that from mines in Canada decreased 3,227,000 ounces. The total decrease in the world's production of silver in 1920 was about 2,247,000 ounces.

World's production of silver, 1916–1920, in fine ounces.

Country.	1916	1917	1918	1919	1920
North America:					
United States	74,414,800	71,740,400	67,810,100	56,682,400	55,361,600
Canada	25,459,700	22,221,300	21,284,600	16,020,700	12,793,500
Mexico	22,838,400	35,000,000	62,517,000	65,904,200	66,662,200
Central America	2,602,500	2,369,500	2,900,000	2,800,000	2,700,000
South America:					
Bolivia and Chile	4,402,100	4,151,600	4,335,000	4,335,000	4,000,000
Argentina	21,300	29,000	25,000	25,000	20,000
Brazil	22,000	25,000	25,000	25,000	20,000
Colombia	309,400	325,000	325,000	494,300	480,000
Ecuador	30,000	45,000	40,000	40,000	35,000
Peru	10,787,000	10,864,400	10,800,000	9,821,700	9,196,300
Guiana and Uruguay	8,500	8,000	8,000	8,000	8,000
Venezuela	.....	3,300	3,000	4,100	4,000
Europe:					
Czechoslovakia	.....	.....	.....	596,400	694,000
Austria-Hungary	1,500,000	1,500,000	1,750,000		
France	.....	.....	.....	12,000	12,000
Great Britain	86,500	75,000	50,000	68,400	50,000
Greece	350,000	350,000	350,000	160,000	150,000
Italy	486,500	486,500	500,000	350,000	350,000
Norway	439,100	294,900	270,200	312,800	346,700
Spain and Portugal	4,517,800	2,850,000	3,100,000	1,548,200	3,191,400
Russia	550,000	500,000	400,000	400,000	50,000
Serbia	10,000	20,000	20,000	20,000	15,000
Sweden	37,900	35,000	31,500	31,500	30,000
Turkey	500,000	400,000	400,000	100,000	100,000
Australasia	10,700,000	10,000,000	10,000,000	7,188,000	7,468,600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310,000,000
285,000,000
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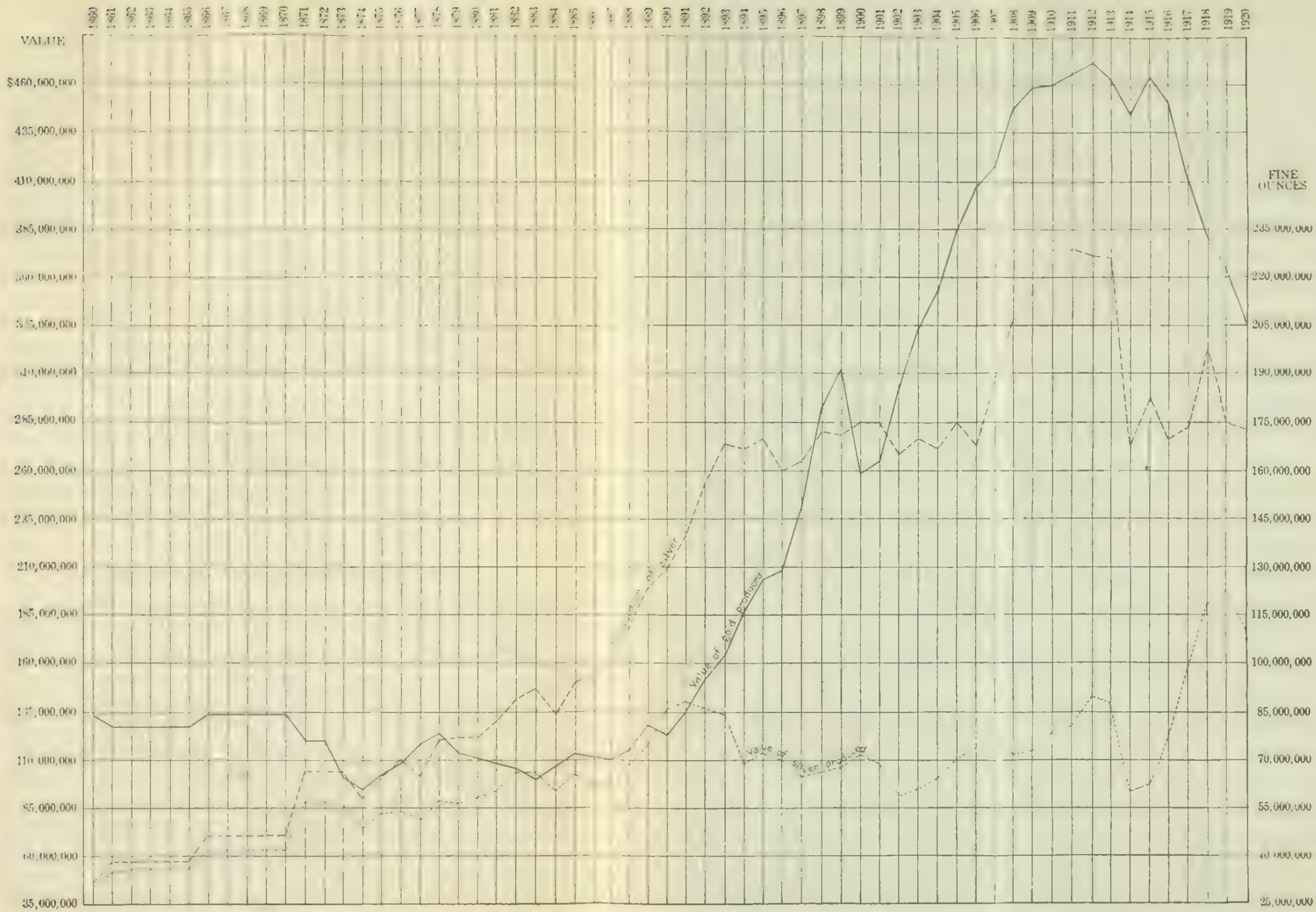

CURVES SHOWING PRODUCTION AND VALUE OF GOLD AND SILVER IN THE WORLD, 1860-1920

World's production of silver, 1916–1920, in fine ounces—Continued.

Country.	1916	1917	1918	1919	1920
Asia:					
British India	280,000	275,000	270,000	190,600	170,600
China	30,000	63,900	70,000	65,000	70,000
Chosen (Korea)	25,000	26,500	26,000	20,000	25,000
Dutch East Indies	400,000	400,000	400,000	1,006,800	1,028,000
Indo-China	1,000	1,000	1,000	1,000	1,000
Formosa	47,700	39,600	26,900	25,000	25,000
Japan	5,805,700	7,111,700	6,600,400	4,950,500	5,212,400
Burma	977,100	1,793,700	1,970,500	1,975,000	2,700,000
Sarawak				6,300	5,200
Africa:					
Algeria				170,800	150,000
Belgian Kongo	11,000	10,300	10,500	10,000	10,700
Egypt	1,200	900	800	300	300
French East Africa, Madagascar	20,000	20,000	20,000	17,700	17,700
Rhodesia	200,700	212,000	175,700	180,600	164,900
Transvaal, Cape Colony, Natal	968,900	938,100	877,500	891,300	892,600
Portuguese East Africa	1,200	1,200	1,200	1,000	1,000
	168,843,000	174,187,800	197,394,900	[a] 176,459,600	[b] 174,212,700

[a] Revised figures. [b] Estimates for 1920 will be revised in the report for 1921.

The value of the silver produced in the world in 1920 was $177,592,400, and the total value from 1860 to 1920, inclusive, was $5,978,119,200.

Most of the world's output of silver is produced or refined in the United States, but a large part of it is consumed in Great Britain, India, and China, and the price of silver has been dominated by the London market. "Silver, its romance and history," by Benjamin White, contains information relating to the buying and selling of silver and the fixing of the market quotations, which was quoted in the chapter on gold and silver in Mineral Resources for 1918.

MINES REPORT.

METHOD OF COLLECTING STATISTICS.

The first table below presents the final official figures of the production of gold and silver in the United States in 1920 as agreed upon by the Bureau of the Mint and the United States Geological Survey. With the comparatively unimportant exceptions of domestic gold and silver contained in ores and mattes exported for reduction during the year, these figures record the actual production of gold and silver bullion from domestic ores in marketable form as metals, either refined or unrefined.

Owing to the difficulty of tracing this total gold and silver produced back to its source by States, counties, and mining districts, however, the Geological Survey attacks this problem of distribution by systematic investigation of the "mine production" of ores containing gold and silver during the calendar year and of the output of the placer mines. In this way the state of the mining industry is studied in detail, and the output is classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mines reports.

Of the two plans for ascertaining the gold and silver production of the United States one is a measure of the mining industry and the other a measure of the metallurgic industry; one reports the mine output and its recoverable content and the other the metal actually recovered in marketable form. The two methods will not produce exactly corresponding results, but the figures for a period of years sufficiently long to compensate for overlap or lag should agree within allowable limits of error due to the complexity of the problem involved.

Gold and silver produced in the United States, 1905–1920, according to mint and to mine returns.

Year.	Mint.		Mine.	
	Gold.	Silver.	Gold.	Silver.
		Ounces.		*Ounces.*
1905–1915	$1,038,286,100	671,818,275	$1,031,369,692	672,280,562
1916	92,590,300	74,414,802	92,822,430	78,875,176
1917	83,750,700	71,740,362	82,032,745	70,665,531
1918	68,646,700	67,810,139	67,701,936	68,063,090
1919	60,333,400	56,682,445	58,225,112	51,907,869
1920	51,186,900	55,361,573	50,537,281	56,559,022
	1,394,794,100	997,827,596	1,382,689,196	998,351,250

These figures show, according to the reports of the Mint, a total excess of gold for the 16 years of $12,104,904, or a difference of less than 1 per cent, and a total deficit of silver of only 523,654 ounces, or a difference of about 0.05 per cent. The figures for Alaska placers are not considered to be so closely approximate as the total figures for gold, hence the differences for the United States proper are probably even lower. It is thought that those small differences are fully accounted for in the detailed discussions of the subject in previous reports of this series. For any one year an excess of mining over smelting and refining is indicated by larger returns in the mines reports for gold or silver, or both, and an excess of smelting and refining and drawing upon stocks is indicated by larger returns in the report of the Mint.

UNITS OF MEASUREMENT.

In the measurement of ores and concentrates the short ton of 2,000 pounds is used throughout. The price of gold is fixed by law at $20.67+ per fine ounce. The annual average prices for silver from 1865 to 1920, are given on page 513.

PRODUCTION OF GOLD AND SILVER REPORTED FROM THE MINES.

The following table gives the quantity and value of the output of recoverable gold and silver ("mine production") by States reported from the producing mines in 1920 to the United States Geological Survey. The increase or decrease of production shows results by comparison with the corresponding Geological Survey mine figures for 1919.

Mine production of gold and silver in the United States in 1920.

State or Territory.	Gold.		Silver.		Increase or decrease.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.	Gold.	Silver (fine ounces).
Alabama	14.32	$296	9	$10	+$296	+9
Alaska	404,683.97	8,365,560	953,546	1,039,365	−1,060,472	+323,838
Arizona	231,528.65	4,786,122	5,355,303	5,837,280	+ 279,709	+88,698
California	692,296.70	14,311,043	1,706,327	1,859,896	−2,384,912	+599,138
Colorado	366,504.43	7,576,319	5,409,335	5,896,175	−2,310,308	−348,675
Georgia	35.41	732	194	211	−35	+186
Idaho	23,490.42	485,590	7,326,794	7,986,205	−227,648	+1,747,738
Illinois	.....	.....	8,193	8,930	.....	+3,753
Maine and Vermont	.....	.....	.....	.....	−522	−6,356
Massachusetts and Pennsylvania	8.61	178	1,250	1,362	+178	+1,250
Michigan	.....	.....	470,189	512,506	.....	+28,759
Missouri	.....	.....	111,128	121,130	.....	+20,727
Montana	89,550.11	1,851,165	12,579,178	13,711,304	−378,423	+37,997
Nevada	172,540.46	3,566,728	7,745,093	8,442,151	−974,774	+881,513
New Mexico	23,234.61	480,302	768,042	837,166	−175,354	−69,376
North Carolina	55.49	1,147	10	11	+1,127	−9
Oregon	49,221.08	1,017,490	82,743	90,190	+39,645	−28,378
Philippine Islands	61,753.64	1,276,561	22,118	24,109	−33,161	+13,709
South Carolina	16.06	332	1	1	+251	−18
South Dakota	226,224.23	4,676,470	90,795	98,966	−186,570	−25,698
Tennessee	282.02	5,830	110,719	120,684	+168	+12,431
Texas	.....	.....	511,401	557,427	−25	−27,241
Utah	97,454.15	2,014,556	13,106,976	14,286,604	−144,915	+1,457,015
Washington	5,846.60	120,860	199,678	217,649	−132,002	−59,706
Wyoming	.....	.....	.....	.....	−84	−151
	2,444,740.96	50,537,281	56,559,022	61,649,332	−7,687,831	+4,651,153

The decrease in the production of gold in 1920 followed a decrease of $9,476,824 in 1919, of $14,330,809 in 1918, and of $10,789,685 in 1917. The increase in silver followed a decrease of 16,155,221 ounces in 1919.

The principal gold-producing States in 1920 were California, Alaska, Colorado, Arizona, South Dakota, and Nevada, and these six States together made about 86 per cent of the total output. The only notable increase in gold was in Arizona. The most notable decreases in gold were in California, Colorado, Alaska, Nevada, Montana, Idaho, South Dakota, New Mexico, Utah, and Washington. Every State that yielded more than $2,000 in gold, except Arizona, Oregon, and Tennessee, had a decreased output in 1920.

The principal silver-producing States in 1920 were Utah, Montana, Nevada, Idaho, Colorado, and Arizona, and these six States together produced more than 91 per cent of the total for the United States. The comparatively large decreases in 1920 were in Colorado, New Mexico, and Washington. There were increases in Idaho, Utah, Nevada, California, and Alaska.

About $28,071,000 in gold, or 56 per cent of the entire output in the United States in 1920, was produced by 25 companies, none of which produced less than $400,000. The largest producer was the celebrated Homestake mine in South Dakota. Eighteen of the larger properties produced gold from dry or siliceous ores, three produced it from gravels by dredging, and four recovered gold in the treatment of copper ores. Eight of the largest producers of gold in 1920 were in California, six in Colorado, four in Alaska, and three in Arizona.

Larger producers of gold in the United States in 1920, in order of output.

Rank.	Operator.	State.	Mining district.	Source of gold.
1	Homestake Mining Co.	South Dakota	Whitewood	Dry and siliceous ores.
2	Yuba Consolidated Goldfields	California	Marysville	Dredging gravels.
3	United Eastern Mining Co.	Arizona	Oatman	Dry and siliceous ores.
4	Natomas Co. of California	California	Oroville and Folsom.	Dredging gravels.
5	Empire Mines	do	Grass Valley	Dry and siliceous ores.
6	Chichagoff Mining Co.	Alaska	Sitka	Do.
7	Portland Gold Mining Co.	Colorado	Cripple Creek	Do.
8	Alaska Gastineau Mining Co.	Alaska	Juneau	Do.
9	Cresson Consolidated Mining Co.	Colorado	Cripple Creek	Do.
10	Carson Hill Gold Mines	California	Mother Lode	Do.
11	Tom Reed Gold Mining Co.	Arizona	Oatman	Do.
12	Alaska Juneau Mining Co.	Alaska	Juneau	Do.
13	North Star Mines	California	Grass Valley	Do.
14	Plymouth Consolidated Mining Co.	do	Mother Lode	Do.
15	Utah Copper Co.	Utah	West Mountain	Copper ores.
16	Tomboy Gold Mines Co.	Colorado	Upper San Miguel.	Dry and siliceous ores.
17	Alaska United Mining Co.	Alaska	Juneau	Do.
18	Calumet & Arizona Mining Co.	Arizona	Turquoise	Copper ores.
19	Yukon Gold Dredging Co.	California	Oroville and Folsom.	Dredging gravels.
20	Smuggler Union Mining Co.	Colorado	Upper San Miguel.	Dry and siliceous ores.
21	Nevada Consolidated Mining Co.	Nevada	Robinson	Copper ores.
22	Central Eureka Mining Co.	California	Mother Lode	Dry and siliceous ores.
23	Ibex Mining Co.	Colorado	Leadville	Do.
24	Vindicator Consolidated Gold Mining Co.	do	Cripple Creek	Do.
25	Anaconda Copper Mining Co.	Montana	Summit Valley	Copper ores.

Exclusive of the output of gold of the large producing operators, about $22,466,000 came from the operation of about 3,300 placer and deep mines, many of which produced between $100,000 and $400,000 each. Hundreds of mines, especially placer properties in California, Oregon, Idaho, Alaska, Arizona, and the Appalachian States, produced very small quantities of gold, and the average output of the smaller mines was less than $7,000.

The largest output of silver was that of the Anaconda Copper Mining Co. Of the mines enumerated in the subjoined list, 5 recovered silver from copper ore, 11 from lead ore, 7 from dry and siliceous ore, and 2 from zinc-lead ore. The California Rand mine in California and the Presidio mine in Texas were the largest producers of silver from ore that contained no appreciable quantity of any other metal. The approximate output of the 25 properties was 28,900,000 ounces, or more than half of the total production of silver in the United States in 1920, as against about half in 1919. Seven of the largest producers were in Utah, five each in Montana and Idaho, and four in Nevada.

Larger producers of silver in the United States in 1920, in order of output.

Rank.	Operator.	State.	Mining district.	Source of silver.
1	Anaconda Copper Mining Co...	Montana.....	Summit Valley...	Copper ores.
2	Chief Consolidated Mining Co..	Utah.....	Tintic.....	Lead and siliceous ores.
3	Tintic Standard Mining Co.....	.....do.....	.....do.....	Do.
4	Hercules Mining Co.....	Idaho.....	Leland.....	Lead ores.
5	Tonopah-Belmont Development Co.	Nevada.....	Tonopah.....	Dry and siliceous ores.
6	Butte & Superior Mining Co...	Montana.....	Summit Valley...	Lead-zinc ores.
7	Bunker Hill & Sullivan Mining Co.	Idaho.....	Yreka.....	Lead ores.
8	California Rand Silver (Inc.)...	California.....	Randsburg.....	Dry and siliceous ores.
9	Tonopah Extension Mining Co.	Nevada.....	Tonopah.....	Do.
10	Elm Orlu Mining Co.....	Montana.....	Summit Valley...	Lead-zinc ores.
11	Davis Daly Copper Co.....	.....do.....	.....do.....	Copper ores.
12	Federal Mining & Smelting Co.	Idaho.....	Hunter.....	Lead ores.
13	Hecla Mining Co.....	.....do.....	Leland.....	Do.
14	United Verde Copper Co.....	Arizona.....	Verde.....	Copper ores.
15	West End Consolidated Mining Co.	Nevada.....	Tonopah.....	Dry and siliceous ores.
16	North Butte Mining Co.....	Montana.....	Summit Valley...	Copper ores.
17	Ontario Silver Mining Co.....	Utah.....	Uintah.....	Lead ores.
18	Calumet & Arizona Mining Co..	Arizona.....	Warren.....	Copper ores.
19	Tonopah Mining Co.....	Nevada.....	Tonopah.....	Dry and siliceous ores.
20	Silver King Coalition Mining Co.	Utah.....	Uintah.....	Lead ores.
21	Eagle & Blue Bell Mining Co...	.....do.....	Tintic.....	Lead and siliceous ores.
22	Vipont Silver Mining Co.....	.....do.....	Ashbrook.....	Dry and siliceous ores.
23	Tamarack & Custer Consolidated Mining Co.	Idaho.....	Placer center.....	Lead ores.
24	Daly West Mining Co.....	Utah.....	Uintah.....	Do.
25	Presidio Mining Co.....	Texas.....	Shafter.....	Siliceous (silver) ores.

MINE PRODUCTION OF GOLD AND SILVER, BY STATES.

ALASKA.

The total production of gold in Alaska from the earliest mining, in 1880, to the end of 1920 is estimated at $320,030,553, and that of silver at 9,972,562 fine ounces.

Gold.—The yield from siliceous ores increased from $4,392,237 in 1919 to $4,473,687 in 1920; that from copper ores decreased from $63,795 to $18,873; the placer output was $3,873,000, against $4,970,000. Twenty-two dredges produced $1,129,932 of the placer gold, which was $230,068 less than the dredge output in 1919.

The 3,413,736 tons of siliceous ores treated in 1920 yielded an average of $1.39 in gold and silver a ton, and the 765,025 tons of copper ore contained $1 in gold and silver a ton and had a copper content of 4.6 per cent.

About 53 per cent of the total output of gold in Alaska came from gold lode mines in 1920, against 47 per cent in 1919, 37 per cent in 1918, 31 per cent in 1917, and 29 per cent in 1912. The 570 placers operated in 1920 yielded 3,440,000 cubic yards of auriferous gravel, of which the dredges handled 1,634,000 cubic yards and made an average recovery of 69 cents a cubic yard in 1920, against 77 cents in 1919 and 57 cents in 1918. The estimated total recovery of gold by dredging for the period 1903–1920 is $21,524,826.

No important new placer-bearing areas were reported in 1920.

Silver.—The mine production of silver in Alaska in 1920 was 953,546 fine ounces, against 629,708 ounces in 1919. The copper mines produced 682,033 ounces, an increase of 193,999 ounces; the siliceous ores 246,292 ounces, against 108,691 ounces in 1919; and the placers 25,221 ounces, against 32,983 ounces.

ARIZONA.

Gold.—The mine production of gold in Arizona in 1920 was $4,786,122, or $279,709 more than in 1919. Placers contributed only $4,567. The deep mines produced $4,781,555, of which 65 per cent came from dry or siliceous ores mined chiefly in Mohave, Yavapai, and Cochise counties; and 33 per cent was contained in copper ores mined chiefly in Cochise and Yavapai counties. Mohave County had a gold output of $2,852,141, Cochise County $919,167, and Yavapai County $659,541. The gold recovered from ores treated at gold and silver mills represented about 60 per cent of the total output, against 57 per cent in 1919, and crude ores shipped to smelters contained nearly 32 per cent. The crude copper ores mined and smelted directly (without previous concentration) contained an average gold content of about 55 cents a ton.

Silver.—The mine production of silver in Arizona increased from 5,266,605 fine ounces in 1919 to 5,355,303 ounces in 1920. Of this output 3,716,246 ounces came from copper ores, 1,051,982 ounces from dry and siliceous ores, 521,441 ounces from lead ores, and 65,619 ounces from copper-lead ores. Cochise County produced 2,314,977 ounces in 1920, of which 1,362,349 ounces came from copper ores and 584,452 ounces from siliceous ores; and Yavapai County produced 1,555,075 ounces, derived mainly from copper ores. Bullion recovered from gold and silver ores, almost all by cyanidation, contained 129,671 ounces of silver, concentrates 1,125,502 ounces, and crude ore shipped to smelters 4,070,064 ounces.

CALIFORNIA.

Gold.—In 1920 the deep mines produced $7,250,430 (a decrease of $1,412,449), of which gold-quartz ores yielded 98.7 per cent. California placers in 1920 produced $7,060,613 in gold, or $972,463 less than in 1919. Of the placer production $6,900,366 was recovered by dredging. The total dredge production from 1896 to the end of 1920 has been $117,243,197, and the production by dredges in 1920 was equal to 48 per cent of the total gold for 1920. The Yuba County dredges, 10 in number, made the largest output, the value being $3,456,452, a decrease of $729,474. Sacramento County, with 9 dredges working, made an output of $1,574,744, a decrease of $137,961. In Butte County (including Oroville and other districts) 4 dredges produced $441,650 in gold, or $80,046 more than in 1919. Dredges were also operated in Calaveras, Amador, Stanislaus, Placer, Shasta, Siskiyou, San Joaquin, and Trinity counties.

Five of the 29 counties reporting mine production of gold each had a yield of more than $1,000,000 in 1920. Of these Yuba and Sacramento obtained most of their gold by dredging; Amador and Calaveras are on the Mother Lode; and Nevada County produced mainly from siliceous ores of the Grass Valley district. The five Mother Lode counties—Amador, Calaveras, Eldorado, Mariposa, and Tuolumne—whose output is mainly gold milling ores, produced $2,558,597 in gold from mill bullion and $862,845 from concentrates in 1920, against $3,321,121 from mill bullion and $1,515,317 from concentrates in 1919.

Silver.—The mine production of silver in California in 1920 was 1,706,327 fine ounces—an increase of 599,138 ounces. Siliceous ores yielded 1,243,971 ounces, copper ores 179,752 ounces, lead ores 252,704 ounces, and placers the remainder. The only counties producing more than 100,000 ounces of silver in 1920 were San Bernardino, Plumas, and Inyo. About 78 per cent of all the silver was recovered from crude ores sent to smelters.

COLORADO.

Gold.—The total mine production of gold in Colorado in 1920 was $7,576,319, a decrease of $2,310,308, following decreases of $2,865,091 in 1919, $3,424,597 in 1917, and $2,977,506 in 1918. The Cripple Creek district, with a decrease of $1,503,818, produced $4,323,998 in gold, or 57 per cent of the State output from all sources.

The San Juan region, in Dolores, La Plata, Ouray, San Juan, and San Miguel counties, produced $1,654,139; and Lake County produced $768,365, an increase of $142,409. Siliceous and dry ores, 78 per cent of all the ore sold or treated, yielded 86 per cent of the total output of gold; a little more than 3 per cent came from lead ore; nearly 7 per cent from placers; and the remainder from other classes of ore.

The placer production in 1920 was $514,588, a decrease of $35,974. Summit County produced more than 72 per cent and Lake County nearly 27 per cent of the placer gold. Dredges in these two counties recovered more than 99 per cent of the placer gold.

Silver.—The mine production of silver in Colorado in 1920 was 5,409,335 fine ounces, a decrease of 348,675 ounces. Lake County, principally Leadville, produced 1,099,688 ounces, a decrease of 442,636 ounces. San Miguel County produced 1,064,667 ounces, a decrease of 36,275 ounces. Siliceous and dry ores yielded 67 per cent of the silver recovered, lead ores 15.6 per cent, lead-zinc ores 13.4 per cent, and copper ores less than 2 per cent. The remainder came from placers, zinc ores, and copper-lead ores.

IDAHO.

Gold.—The mine production of gold in Idaho in 1920 was $485,590, a decrease of $227,648. The total production of gold from Idaho from the discovery of placer gold in 1863 to the end of 1920 is estimated at $132,812,613 by C. N. Gerry.[3]

Boise County produced about 55 per cent of the total output in 1920. The lode mines produced gold valued at $371,776 and the placers $113,814, of which $101,679 was won by dredging. The total output of gold recovered by dredges from 1897 to the end of 1920 has been $4,287,798. Of the total gold in 1920 about 23 per cent came from placers, 58 per cent from siliceous ores, 6 per cent from copper ores, and the remainder from lead, copper-lead, and lead-zinc ores.

Silver.—The mine production of silver in Idaho in 1920 was 7,326,794 fine ounces, or 1,747,738 ounces more than in 1919. The total silver from Idaho for the period 1863 to 1920, inclusive, amounts to 246,784,145 fine ounces.[3]

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[3] U. S. Geol. Survey Mineral Resources, 1920, pt. 1, p. 239.

Shoshone County produced more than 87 per cent of the total quantity in 1920, 86 per cent in 1919, 92 per cent in 1918, 93.4 per cent in 1917. Lead ores contained 83 per cent of the output of silver and lead-zinc ores nearly 12 per cent. Crude ore shipped, which averaged 18.28 ounces of silver a ton, supplied more than 25 per cent of the silver, and concentrates, which averaged 19.70 ounces of silver a ton, contained more than 74 per cent of the total silver.

MASSACHUSETTS AND PENNSYLVANIA.

A small quantity of ore was shipped in 1920 from the Chipman mine at Newburyport, in Massachusetts, and from a prospect near Phoenixville, in Pennsylvania. These ores contained $178 in gold and 1,250 ounces of silver.

MICHIGAN.

Silver.—The copper mines of Michigan produced 470,189 fine ounces of silver in 1920, against 441,430 fine ounces in 1919. The silver was derived mainly from the electrolytic treatment of 38,907,000 pounds of copper. The average recovery of silver per ton of "rock" treated was 0.289 ounce.

MISSOURI, OKLAHOMA, ILLINOIS, AND KENTUCKY.

Silver.—The lead and zinc mines of the Central States produce no gold and only a comparatively small quantity of silver. Nearly all the silver is a by-product from the refining of lead from concentrates of lead ores mined in southeastern Missouri. The total yield of silver from Missouri in 1920 was 111,128 fine ounces, which, with the exception of 28,664 ounces recovered from cobalt-nickel-copper ore and copper concentrates, was derived from lead recovered from 90,000 tons of galena concentrates. The average recovery was slightly more than 0.91 ounce of silver per ton of concentrate smelted.

The lead-zinc fluorspar deposits of the Kentucky-Illinois field carry silver, and from the lead concentrates shipped from Illinois in 1920 a recovery of 8,193 ounces of silver was obtained, against 4,440 ounces in 1919. The average silver content per ton recovered from lead concentrates from Illinois in 1920 was 6.55 ounces. No silver ore was shipped from the Criswell mine, near Byars, McClain County, Okla., in 1920.

MONTANA.

Gold.—The mine production of gold in Montana decreased from $2,229,588 in 1919 to $1,851,165 in 1920, and the placer output was $288,946—a decrease of $2,484. Silver Bow County had the largest total output, $647,013. Most of the placer gold was recovered by one company, which operated a dredge in Alder Gulch, in Madison County. Lewis and Clark County produced $335,036 and Deer Lodge County $121,512, chiefly from siliceous ores. At amalgamation and cyanidation plants $533,798 in gold was recovered, an average of $6.45 per ton of ore and tailings treated. Ore treated at concentration mills yielded concentrates containing $575,479, or 55 cents a ton, and crude ore shipped to smelters contained $402,339 in gold, an average of $2.21 a ton.

Silver.—Montana mines produced 12,579,178 fine ounces of silver in 1920, an increase of 37,997 ounces. The copper ores yielded 6,030,507 ounces (an average of 1.5 ounces per ton), of which Silver Bow County (Butte) supplied 6,022,351 ounces. The lead-zinc ores produced 2,531,685 ounces, of which Silver Bow County supplied 2,424,327 ounces. The dry or siliceous ores produced 2,000,162 ounces, of which Granite County supplied 644,179 ounces and Silver Bow County 954,057 ounces.

NEVADA.

Gold.—The mine production of gold in Nevada in 1920 was $3,566,728, against $4,541,502 in 1919. The Goldfield district produced $155,789, against $740,265 in 1919. Nye County produced $1,479,579, of which $1,056,986 was from Tonopah, whose increase was more than $285,000.

Silver.—The mine production of silver in Nevada in 1920 was 7,745,093 fine ounces, against 6,863,580 ounces in 1919. Nye County (almost wholly from the Tonopah district) again led with 4,903,987 ounces, about 1,281,000 ounces more than in 1919. All but 805,514 ounces came from dry and siliceous ores, and 69 per cent of this output was recovered by cyanidation.

NEW MEXICO.

Gold.—The mine production of gold in New Mexico in 1920 was $480,302, against $655,656 in 1919. Hidalgo County produced $153,659; Socorro County, $125,631; Grant County, $89,766; and Colfax and Lincoln counties, $87,466.

Copper ores, chiefly from Grant County, contained $123,868 in gold, and dry and siliceous ores, $343,735. The output from other kinds of ore was very small, and the placer output was only $2,188.

Silver.—The mine production of silver in New Mexico decreased from 837,418 fine ounces in 1919 to 768,042 ounces in 1920. Socorro County produced 347,856 fine ounces, chiefly from siliceous ores from the Mogollon district, the remainder from the mixed ores of the Magdalena district. The output of silver from Grant County decreased from 336,499 ounces in 1919 to 81,299 ounces in 1920.

OREGON.

Gold.—The mine production of gold from Oregon increased from $977,845 in 1919 to $1,017,490 in 1920. The placer mines produced $451,117, or $70,466 more in 1920 than in 1919. About 70 per cent of the output from deep mines was from siliceous ores. The deep mines of the State produced $566,373, a decrease of $30,821. Two dredges in Baker County and one dredge in Grant County produced $358,864, and a few drift and hydraulic mines and surface placers in Baker, Coos, Curry, Jackson, Douglas, Josephine, and Wheeler counties produced the remainder of the placer gold. Baker County only ($890,380) produced more than $70,000 in gold.

Silver.—The mine production of silver in Oregon in 1920 was 82,743 fine ounces—a decrease of 28,378 ounces. Of the total production 59,000 ounces came from siliceous ores, 18,890 ounces from copper ores, and 4,853 ounces from placer bullion.

SOUTH DAKOTA.

The total value of the gold produced in South Dakota from 1876 to the end of 1920 is given by Charles W. Henderson,[4] of the United States Geological Survey, as $223,623,669, and the total output of silver for the same period as 6,800,993 fine ounces.

Gold.—The mine production of gold in South Dakota in 1920 was $4,676,470, against $4,863,040 in 1919. The output was almost wholly from siliceous milling ores of low grade, of which nearly 65.5 per cent was recovered by amalgamation and the remainder by cyanidation. The Homestake mines and mills produced $4,410,194 in bullion from 1,274,944 tons of ore treated.

The small yield of placer gold (28 ounces) came from Lawrence County.

Silver.—The mine output of silver, derived mainly from refining the gold bullion produced, was 90,795 fine ounces, or 25,698 ounces less than in 1919.

SOUTHERN APPALACHIAN STATES.

The total production of gold from 1799 to the end of 1920 in the southern Appalachian States, as shown from data compiled by the Bureau of the Mint and the United States Geological Survey, has been $51,035,798. The figures credit Alabama with $766,632, Georgia with $17,825,268, North Carolina with $23,629,580, Tennessee with $264,502, Virginia with $3,296,569, South Carolina with $5,181,842, and Maryland with $71,405.

Gold.—The combined mine production of gold in the southern Appalachian States in 1920 was $8,337, against $6,530 in 1919. Tennessee led with $5,830; North Carolina was next with $1,147. The gold produced in Tennessee was from copper ores of the Ducktown district. The production of gold from placers amounted to 57.18 ounces. Copper ores, from Tennessee, yielded about 282 ounces of gold, and siliceous ores from North Carolina, Alabama, and Georgia yielded about 36 ounces.

Silver.—Copper ores in Tennessee yielded 110,719 ounces of silver in 1920. Siliceous ores and placer bullion yielded only 21 ounces.

TEXAS.

The total output of gold from Texas mines from 1885 to the end of 1920 is given by Charles W. Henderson as $43,607, and the output of silver for the same period was 15,293,734 ounces.

The small annual yield of gold has been mainly a by-product, and none was reported in 1920.

The mine production of silver from Texas in 1920 was 511,401 fine ounces, against 538,642 ounces in 1919. The greater part of the silver continued to come from the Presidio silver mine and cyanidation mill in the Shafter district, Presidio County. The silver contained in copper ores shipped in 1920 amounted to 2,800 ounces.

[4] U. S. Geol. Survey Mineral Resources, 1920, pt. 1, p. 152.

UTAH.

Gold.—The total output of gold in Utah from 1864 to 1920, inclusive, is given by V. C. Heikes, of the United States Geological Survey, as $100,242,530.[5]

The mine production of gold decreased from $2,159,471 in 1919 to $2,014,556 in 1920. The Bingham district (Salt Lake County), produced $1,054,915 and the Tintic district, partly in Juab County and partly in Utah County, produced $603,690. The placer gold in 1920 amounted to $453 and the output recovered by cyanidation and amalgamation was about $87,525. About 32.7 per cent of the Utah gold was derived from copper ores mainly mined in Salt Lake and Juab counties; lead and lead-zinc ores contained 32.9 per cent.

Silver.—The total output of silver in Utah from 1864 to 1920, inclusive, has been 404,233,061 fine ounces, according to Heikes.[5]

The mine production of silver in Utah in 1920 was 13,106,976 ounces, an increase of 1,457,015 ounces. The largest production was from Juab County, credited with 4,650,273 ounces (mainly from lead ores), against 4,822,227 ounces in 1919. Utah County had the next largest output, 2,282,461 ounces (from lead and siliceous ores), against 1,993,381 ounces in 1919. Of the Salt Lake County output of 2,053,372 ounces, the Bingham district produced 1,589,972 ounces. The Tintic district, in Juab and Utah counties, produced 6,884,740 ounces (mainly from lead ores); and the Park City region, in Summit and Wasatch counties, produced 2,672,389 ounces, mainly from lead and lead-zinc ores. Altogether in 1920 the lead ores of Utah yielded 7,895,007 ounces of silver, the copper ores 452,915 ounces, the lead-zinc ores 630,875 ounces, and the dry and siliceous ores 3,955,771 ounces. The crude ore smelted in 1920 contained 10,338,616 ounces and concentrates contained 2,191,040 ounces.

WASHINGTON.

The total production of gold in Washington from earliest mining to the end of 1920 is given by C. N. Gerry, of the United States Geological Survey, as $28,127,072, and the total production of silver as 7,822,595 fine ounces.[6]

Gold.—The mine production of gold in Washington in 1920 was $120,860, against $252,862 in 1919. Of this production nearly 95 per cent was derived from ores shipped directly to smelters, and more than 1 per cent came from placers; siliceous ores supplied nearly 95 per cent and copper ores less than 1 per cent. Ferry County alone produced $110,278 in 1920, against $245,141 in 1919. Nearly all the yield from Ferry County was, as usual, from the Republic district.

Silver.—The mine production of silver in Washington decreased from 259,384 ounces in 1919 to 199,678 ounces in 1920, of which Ferry County produced 33,274 ounces, mainly from siliceous ores, and Stevens County 134,037 ounces, mainly from copper ores.

[5] U. S. Geol. Survey Mineral Resources, 1920, pt. 1, p. 285.
[6] Idem, p. 261.

WYOMING.

The total production of gold in Wyoming from 1867 to the end of 1920 is given by Charles W. Henderson[7] as $1,236,059, and the output of silver for the same period as 69,691 ounces.

No production of gold or silver was reported by mines in Wyoming in 1920.

PHILIPPINE ISLANDS.

The output of gold in the Philippine Islands from 1907 to 1920, inclusive, has been $11,635,805. The mine production of gold for 1920 was $1,276,561, against $1,309,722 in 1919, $1,290,000 in 1918, $1,408,161 in 1917, $1,514,200 in 1916, $1,320,900 in 1915, $1,371,514 in 1914, $868,362 in 1913, and $570,212 in 1912.

The milling plant of the Benguet Consolidated Mining Co. in the Province of Luzon, the largest producer of gold in the Philippine Islands, is described in the Mining and Scientific Press of December 4 and 11, 1920. In 1920 about 35,600 tons of ore were cyanided and yielded $15.02 a ton in gold and silver. The cost of mining and milling the ore was given as $8.02 a ton. Another large producer was the Colorado mine at Aroroy.

The mine production of silver in the Philippine Islands in 1920 was 22,118 ounces and was recovered entirely from gold bullion refined, as no attempt was made to develop the known deposits of silver ore.

NUMBER OF PRODUCING MINES.

The following table indicates the number of mines producing gold and silver in 1920. The placers are those in which the gold and the silver in natural alloy with the gold and, in a few placers, found also with platinum are recovered from gravels and sands, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or by dredging. The deep mines are those producing gold and silver (from ores as distinguished from gravels) mainly from underground workings, including those whose ores are valuable chiefly for copper, lead, or zinc but which contribute precious metals as by-products. In addition to producing mines here enumerated, many properties were being prospected and developed (though prospecting and development were much less active than usual) without making any output in 1920, and many other mining claims were being held by assessment work only.

The enumeration of placer mines is less satisfactory than that of deep mines, because some of the operations are only temporary and individually small and because much of the production is made by transitory miners not regularly working placer ground. The unit so far as possible is, however, as for deep mines, not the operator, but the mining claim or group of claims.

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[7] U. S. Geol. Survey Mineral Resources, 1920, pt. 1, p. 155.

Number of mines producing gold and silver in 1920.[a]

State or Territory.	Placer.	Deep.	Total.
Alabama	.....	1	1
Alaska	570	33	603
Arizona	8	310	318
California	199	301	500
Colorado	11	405	416
Georgia	.....	4	4
Idaho	49	114	163
Illinois [b]	.....	3	3
Massachusetts and Pennsylvania	.....	2	2
Michigan [b]	.....	7	7
Missouri	.....	3	3
Montana	65	392	457
Nevada	39	434	473
New Mexico	6	93	99
North Carolina and South Carolina	2	4	6
Oregon	47	20	67
South Dakota	4	3	7
Tennessee [c]	.....	2	2
Texas	.....	4	4
Utah	3	161	164
Washington	9	35	44
	1,012	2,331	3,343

[a] Philippine Islands and Porto Rico not included.
[b] Number of mines contributing to production of silver.
[c] Number of mines contributing to production of gold and silver.

Number of mines producing gold and silver, 1906—1920.

Year.	Placer.	Deep.	Total.	Year.	Placer.	Deep.	Total.
1906	2,316	2,114	4,430	1915	1,720	3,597	5,317
1907	2,586	2,604	5,190	1916	1,530	3,765	5,295
1908	2,599	2,864	5,463	1917	1,552	3,811	5,363
1909	2,187	3,183	5,370	1918	1,414	3,287	4,701
1910	2,026	3,299	5,325	1919	1,105	2,460	3,565
1911	2,146	3,553	5,699	1920	1,012	2,331	3,343
1912	2,044	3,567	5,611				
1913	1,774	3,502	5,276	Average	1,855	3,140	4,995
1914	1,815	3,158	4,973				

The total number of properties operated in 1920 was 1,652 less than the average for the last 15 years. The number of placer properties worked in 1920 showed a decrease of 93, and the total was 1,304 less than the number operated in 1906. This is a natural result of the exhaustion of the rich gravels and of the acquisition of large areas of placer ground by dredge mining companies. The number of deep mines operated was 809 less than the average for 15 years. Owing to the high cost of labor and material in 1920 fewer deep mines were operated than in any other year since 1906.

ORE PRODUCTION, CLASSIFICATION, AND AVERAGE VALUE.

The best index of deep mining is, of course, found in the quantity, metallic content, and value of ore mined, rather than in the number of mines or of operators. In the next following table are given the production of ore from mines producing gold and silver and the average extraction value of precious metals per ton.

The classification adopted is necessarily arbitrary in part. The complex nature of western ores, especially, and the gradations from one well-recognized class to another render essential a fixed termi-

nology. The dry or siliceous ores comprise gold and silver ores proper, as well as fluxing ores carrying considerable quantities of iron and manganese oxides and very small quantities of gold and silver, and precious metal bearing ores carrying copper, lead, or zinc in quantities too low to classify them as copper, lead, zinc, or mixed ores. The distinction between gold and silver ores is not here made. The total number of silver mines and the total production of true silver ores are both very small. The copper ores include those containing 2.5 per cent or more of copper, or less than this percentage in the great disseminated copper deposits of the West and in the Lake Superior ores; in general, the lead ores are those containing 4.5 per cent or more of lead and the zinc ores are those containing 25 per cent or more of zinc, both irrespective of their precious-metal content; but ores of lower grades in lead and especially in zinc are treated profitably in many districts, and of course they are then classified as lead or zinc ores, as the case may be. The mixed ores are combinations of those enumerated.

The lead, zinc, and lead-zinc ores in many districts in the Eastern and Central States carry no appreciable quantity of gold or silver, and such ores are excluded from this report.

The total quantity of ore sold or treated from which gold or silver was produced increased 2,850,119 short tons in 1920 and had increased more than 17,500,000 tons in the three years prior to 1919. In 1920 the quantity of copper ores sold or treated increased more than 2,528,000 tons; zinc ores more than 393,000 tons; lead-zinc ores, 78,000 tons; lead ores, 553,000 tons; and copper-lead ores about 9,200 tons. The quantity of dry and siliceous ores decreased about 712,000 tons. Arizona, Utah, Montana, Alaska, and Nevada led in quantity of ore, owing to the large output from copper mines in all the States other than Alaska, which yielded mainly siliceous ores; the ore from Arizona and Utah was mainly low-grade disseminated ore, and that from Montana came mainly from the Butte vein deposits. Nevada ore was mainly Ely copper ores but included also siliceous ores from Goldfield, Tonopah, and other districts. New Mexico, Idaho, Michigan, Colorado, South Dakota, and California, were next, with an output consisting mainly of dry or siliceous ores from many districts in California, Colorado, and South Dakota and of copper ores from the low-grade ore bodies in New Mexico and Michigan.

Ore produced and average extraction value of gold and silver per ton in 1920.[a]

State or Territory.	Dry and siliceous ores.		Copper ores.		Lead ores.	
	Quantity (short tons).	Average value.	Quantity (short tons).	Average value.	Quantity (short tons).	Average value.
Alabama and Georgia	320	$1.47				
Alaska	3,413,736	1.39	765,025	$1.00		
Arizona	280,701	15.10	14,516,580	.39	116,269	$5.84
California	788,136	10.80	346,201	.68	29,776	11.05
Colorado	1,224,081	8.56	3,835	40.20	61,254	18.85
Idaho	39,811	9.68	19,259	4.47	1,480,177	4.52
Massachusetts and Pennsylvania[b]					458	3.36
Michigan[b]			1,621,000	.25		
Montana	178,352	17.47	4,002,491	1.74	64,563	14.51
Nevada	799,207	12.98	2,616,237	.22	40,544	15.66
North Carolina and South Carolina	300	1.01				
New Mexico	101,887	9.89	2,090,711	.11	6,931	8.48
Oregon	47,352	9.68	34,804	5.53		
South Dakota	1,356,098	3.52			91	28.52
Tennessee[c]			589,853	.21		
Texas	56,042	9.89	227	13.44		
Utah	291,020	17.18	5,778,373	.20	559,896	16.04
Washington	13,096	12.59	62,814	2.62	8,660	.52
Total, 1920	8,590,139	6.26	32,447,410	.52	2,368,619	8.26
Percentage of quantity	18.94		71.54		5.22	
Total, 1919	9,302,229	6.25	29,919,369	.61	1,815,243	9.33
Percentage of quantity	21.89		70.39		4.25	

State or Territory.	Zinc ores.		Copper-lead and copper-lead-zinc ores.		Lead-zinc ores.		Total (short tons).
	Quantity (short tons).	Average value.	Quantity (short tons).	Average value.	Quantity (short tons).	Average value.	
Alabama and Georgia			240	$3.25			560
Alaska							4,178,761
Arizona	1,820		5,108	14.14			14,920,478
California	909						1,165,022
Colorado	96,232	$1.13	453	26.12	185,438	$5.62	1,571,293
Idaho	2,419	1.29	5,015	49.34	411,720	2.29	1,958,401
Massachusetts and Pennsylvania[b]							458
Michigan[b]							1,621,000
Montana	328,513	4.07	3,032	18.50	664,664	4.31	5,241,615
Nevada	2,898		6,269	29.57	15,465	5.91	3,480,620
North Carolina and South Carolina							300
New Mexico	46,646		294	31.07	4,249	1.19	2,250,718
Oregon							82,156
South Dakota							1,356,189
Tennessee[c]							589,853
Texas							56,269
Utah	2,162		6,389	30.14	162,340	6.00	6,800,180
Washington	630		90	33.21	28		85,318
Wyoming							
Total, 1920	482,229	3.00	26,890	30.01	1,443,904	4.10	45,359,191
Percentage of quantity	1.06		.06		3.18		100.00
Total, 1919	88,654	.52	17,632	15.97	1,365,945	4.91	42,509,072
Percentage of quantity	.21		.04		3.22		100.00

[a] Illinois, Missouri, the Philippine Islands, and Porto Rico not included; quantity of crude ore containing precious metals not known.
[b] Includes only ore yielding precious metals.
[c] Lead and zinc ores yielded no precious metals.

Some of the States produced comparatively small quantities of copper ore carrying high extraction values in gold and silver, but the copper ores of the important copper-producing States showed

low extraction values. The lead ores of Utah showed an average recovery in gold and silver of $16.04 a ton, and the lead ores of Idaho, the leading State, only $4.52 a ton. Of the output of ore considered as producing gold and silver, the proportion of dry and siliceous ore decreased, whereas that of copper ore increased slightly as compared with the output in 1919. The other classes of ore, except lead-zinc ore, also increased. The average precious-metal extraction value per ton of siliceous ores of the United States increased slightly, whereas that of copper, lead, and lead-zinc ores decreased. There were conspicuous increases in the extraction value of zinc and copper-lead ores.

DISTRIBUTION OF MINE PRODUCTION OF GOLD IN 1920, BY SOURCES.

As shown in the following table, more than 89 per cent of the domestic output of gold is obtained from dry and siliceous ore—normally gold quartz and gold-silver quartzose ores—and from placers. The total contribution of gold derived from the great copper, lead, and zinc mines of the country is therefore relatively small, notwithstanding their recent enormous development and production of ore.

The contribution of gold from dry and siliceous ores, which had gradually declined from about 69 per cent in 1910 to about 66 per cent in 1914 and has fluctuated since then, was 63.93 per cent in 1920. The contribution of gold from copper ores, which had increased from 6 per cent in 1914 to 9.6 per cent in 1918 and decreased to 6.78 per cent in 1919, increased again to 7.18 per cent in 1920.

Mine production of gold in 1920, in fine ounces.

State or Territory.	Placers.	Dry and siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama and Georgia	.....	22.21	.....	.....	.....	27.52	.....	49.73
Alaska	187,356.38	216,414.61	912.98	.....	.....	.....	.....	404,683.97
Arizona	220.93	149,518.03	76,402.41	5,352.21	.....	35.07	.....	231,528.65
California	341,557.15	346,284.17	1,860.45	2,594.93	.....	.....	.....	692,296.70
Colorado	24,893.20	315,127.70	2,150.54	11,459.90	554.91	173.47	12,144.71	366,504.43
Idaho	5,505.76	13,806.37	1,418.69	2,497.21	.....	95.83	166.56	23,490.42
Massachusetts and Pennsylvania	.....	.....	.....	8.61	.....	.....	.....	8.61
Montana	13,977.76	45,293.42	18,720.88	3,084.34	3,102.00	228.82	5,142.89	89,550.11
Nevada	7,383.91	136,058.51	22,924.19	3,237.01	.....	2,936.41	.43	172,540.46
New Mexico	105.84	16,628.18	5,992.17	347.23	.....	9.92	151.27	23,234.61
North Carolina and South Carolina	57.18	14.37	.....	.....	.....	.....	.....	71.55
Oregon	21,822.79	19,076.30	8,321.99	.....	.....	.....	.....	49,221.08
South Dakota	27.91	226,189.74	.....	6.58	.....	.....	.....	226,224.23
Tennessee	.....	.....	282.02	.....	.....	.....	.....	282.02
Utah	21.91	33,347.99	31,845.51	18,185.95	.....	223.78	13,829.01	97,454.15
Washington	71.20	5,549.82	223.59	1.99	.....	.....	.....	5,846.60
Total, 1920 [a]	603,001.92	1,523,331.42	171,055.42	46,775.96	3,656.91	3,730.82	31,434.87	2,382,987.32
Value	$12,465,156	$31,490,055	$3,536,030	$966,945	$75,595	$77,123	$649,816	$49,260,720
Percentage of total	25.30	63.93	7.18	1.96	0.15	0.16	1.32	100.00
Total, 1919 [a]	704,377.24	1,780,567.36	186,700.84	41,944.37	85.82	1,043.46	38,563.00	2,753,281.99
Value	$14,560,770	$36,807,594	$3,859,449	$867,067	$1,774	$21,568	$797,168	$56,915,390
Percentage of total	25.58	64.67	6.78	1.52	0.01	0.04	1.40	100.00

[a] Philippine Islands not included.

PLACERS.

GENERAL FEATURES.

The only States showing a considerable increase in placer gold were Oregon (3,409 ounces) and Nevada (984 ounces).

The placer gold is derived chiefly from dredging, from drift mining (which is of decreasing importance in Alaska in frozen ground at no great depth, but of continued importance in California in ancient buried river channels, often at considerable depth), and from hydraulic and sluicing placers. In California, especially, hydraulic mining was of much importance in the past and had become a special branch of the industry in itself, but restrictive laws relative to the débris and to disturbance of navigable streams have in recent years greatly confined mining activity of this kind. Finally, there is a small annual output of gold from dry placers in the Southwest and also a production of gold and platinum from ocean-beach mining in California and Oregon.

Some interesting notes on beach mining in California and Oregon and on dry placers in California, by Charles G. Yale, and on dry placers in Arizona, Nevada, and New Mexico, by V. C. Heikes, were published in the Survey report on gold and silver for 1912, copies of which may still be had on application to the Director, United States Geological Survey, Washington, D. C.

DREDGING.

The value of gold produced by dredging in the United States from the commercial beginning of the industry in 1896 to the end of 1920 has amounted, according to best available data, to $162,628,504, of which $117,243,197 came from California, $21,524,826 from Alaska, $9,365,078 from Montana, $6,328,819 from Colorado, $4,287,798 from Idaho, and $3,554,900 from Oregon.

Brief details of dredging operations have been given in Mineral Resources in the mines reports on gold, silver, copper, lead, and zinc in the Western States and also in earlier reports of the Director of the Mint. A brief history of gold dredging in the United States was given in the general report on gold and silver for the year 1914, and the production of gold obtained by dredging in the United States and the number of dredges operated were given by States for each year from 1896 to the end of 1914. Further information is to be found in reports of geological surveys or mining officials of different States. A comprehensive and very useful report is contained in Bulletin 57 of the California State Mining Bureau. Other valuable treatises are "Dredging for gold in California," by D'Arcy Weatherbe, published by the Mining and Scientific Press, and Bulletins 121 and 127 of the of Bureau Mines.

Gold produced in the United States by dredges, 1896–1920.

Year.	Dredges.	California.	Alaska.	All other States.[a]	Total.
1896	2	$2,000	.....	$42,000	$44,000
1897	6	5,000	.....	113,556	118,556
1898	8	18,887	.....	168,813	187,700
1899	18	206,302	.....	227,876	434,178
1900	27	200,929	.....	319,108	520,037
1901	34	471,762	.....	268,251	740,013
1902	48	867,665	.....	501,857	1,369,522
1903	45	1,475,749	$20,000	420,315	1,916,064
1904	61	2,187,038	25,000	511,679	2,723,717
1905	68	3,276,141	40,000	371,235	3,687,376
1906	76	5,098,359	120,000	503,035	5,721,394
1907	79	5,065,437	250,000	340,265	5,655,702
1908	88	6,536,189	170,901	646,481	7,353,571
1909	96	7,382,950	424,993	975,656	8,783,599
1910	115	7,550,254	800,000	942,786	9,293,040
1911	119	7,666,461	1,500,000	1,159,908	10,326,369
1912	124	7,429,955	2,200,000	1,588,956	11,218,911
1913	116	8,090,294	2,200,000	1,936,642	12,226,936
1914	120	7,783,394	2,350,000	2,379,389	12,512,783
1915	114	7,796,465	2,330,000	2,356,660	12,483,125
1916	113	7,769,227	2,679,000	2,338,487	12,786,714
1917	109	8,313,527	2,500,000	1,736,898	12,550,425
1918	93	7,431,927	1,425,000	1,485,173	10,342,100
1919	91	7,716,919	1,360,000	1,269,297	10,346,216
1920	78	6,900,366	1,129,932	1,256,158	9,286,456
		117,243,197	21,524,826	23,860,481	162,628,504

[a] Other States that have produced gold by dredges are Colorado, which yielded, 1901–1920, $6,328,819; Idaho, 1897–1920, $4,287,798; Montana, 1896–1920, $9,365,078; Oregon, 1902–1920, $3,554,900; and New Mexico, Nevada, South Dakota, Wyoming, Alabama, Georgia, and North Carolina, a combined yield, 1902–1920, of $323,886.

Of the output in 1920 California produced $6,900,366 from 40 dredges, Alaska $1,129,932 from 22 dredges, Montana $255,550 from 3 dredges, Colorado $512,876 from 5 dredges, Idaho $101,679 from 3 dredges, and Oregon $358,884 from 4 dredges. One dredge was operated below Silver City, in Lyon County, Nev., by the Gold Canyon Dredging Co. during the later part of 1920, but no dredges were working in Wyoming, South Dakota, or the Appalachian States.

DRY AND SILICEOUS ORES.

The siliceous ores are in part free-milling (amalgamating), as in Alaska, California, Arizona, and Oregon; both amalgamating and concentrating, as in many States; simply concentrating ores, as in parts of Colorado and Arizona; all-sliming and cyaniding ores; and finally smelting ores. Tailings both from old dumps and from present millings are largely reworked by concentration and subsequent cyanidation. Owing to the increase in the cost of labor and supplies in the last four or five years, much of the old tailings could not be reworked at a profit.

The material smelted consists mainly of concentrates and of siliceous and pyritic ores, which are also valuable as fluxes. Exact figures of relative output by methods and by States are given in another table.

As most of the gold produced in the United States is derived from placer gravels and dry or siliceous ores, including true gold, gold-silver, and silver ores, the following table for certain States, prepared by V. C. Heikes, is of special interest.

Gold produced in six Western States in 1916–1920.

Year.	Total number of producers.	Total quantity of ore mined.	Total gold.[a]	Gold ore.			
				Number of producers.	Quantity.	Gold.	Average content.
Arizona:		*Short tons.*	*Fine ounces.*		*Short tons.*	*Fine ounces.*	*Ounce.*
1916	527	17,033,810	192,801.41	105	164,918	63,562.20	0.385
1917	484	15,770,193	245,173.83	86	236,585	128,801.16	.544
1918	469	19,038,486	262,919.43	63	201,411	141,126.20	.700
1919	339	13,727,403	217,997.72	34	190,069	125,188.13	.659
1920	318	14,920,478	231,528.65	41	201,334	139,857.94	.694
Idaho:							
1916	418	2,718,045	53,977.30	75	69,443	25,068.38	.361
1917	359	2,758,507	38,932.64	70	67,784	24,721.63	.365
1918	301	2,091,619	33,998.72	53	41,481	13,774.92	.332
1919	210	1,457,395	34,502.89	31	44,537	21,989.06	.493
1920	163	1,958,401	23,490.42	17	38,534	13,708.33	.355
Montana:							
1916	513	7,860,425	220,130.15	150	498,082	131,175.61	.263
1917	617	6,307,164	170,147.11	137	411,118	103,835.48	.252
1918	493	7,823,967	150,192.96	90	234,663	74,996.31	.320
1919	457	4,183,594	107,856.32	87	130,922	56,301.56	.430
1920	457	5,241,615	89,550.11	60	98,307	38,284.51	.389
Nevada:							
1916	779	5,941,165	428,904.21	308	817,100	232,699.56	.285
1917	943	6,473,519	336,664.26	287	589,228	171,815.15	.292
1918	714	6,472,579	320,239.45	195	540,320	167,878.58	.311
1919	421	3,187,831	219,695.16	94	163,279	111,170.33	.681
1920	473	3,480,620	172,540.46	106	102,772	48,873.75	.476
Utah:							
1916	318	13,920,643	172,938.06	10	1,308	663.82	.508
1917	334	15,358,481	162,305.67	6	14,728	4,678.60	.318
1918	250	14,705,718	142,666.10	10	222	359.70	1.620
1919	179	6,745,423	104,464.41	6	553	1,528.81	2.764
1920	164	6,800,180	97,454.15	3	19	85.00	4.473
Washington:							
1916	113	164,998	27,944.06	38	70,048	26,932.84	.384
1917	136	172,119	23,816.17	23	65,058	23,166.31	.356
1918	84	138,911	14,737.83	23	45,434	14,070.56	.309
1919	49	100,879	12,232.20	11	25,648	11,951.91	.465
1920	44	85,318	5,846.60	10	12,513	5,510.88	.440

[a] Includes placer production, given in last column on p. 538.

Gold produced in six Western States in 1916–1920—Continued.

Year.	Gold-silver ore.		Silver ore.		Placers.	
	Quantity.	Gold.	Quantity.	Gold.	Number of producers.	Gold.
Arizona:	*Short tons.*	*Fine ounces.*	*Short tons.*	*Fine ounces.*		*Fine ounces.*
1916	1,470	994.00	169,916	8,858.47	23	690.84
1917	1	3.62	80,817	3,192.79	32	832.73
1918	2,415	452.21	91,722	8,421.19	13	204.82
1919	19,536	6,474.19	85,070	4,279.51	15	227.07
1920	1,177	236.75	78,190	9,423.34	8	220.93
Idaho:						
1916	447	227.19	1,793	201.15	162	21,724.87
1917			1,866	207.64	112	6,541.80
1918			4,834	478.53	85	13,371.33
1919	21	15.94	3,693	257.08	72	9,227.63
1920	5	9.55	1,272	88.49	49	5,505.76
Montana:						
1916	999	176.45	24,761	4,075.20	120	34,982.82
1917	7	2.20	33,097	3,335.15	99	22,594.17
1918	233	121.33	51,626	5,495.86	86	19,167.72
1919	118	61.58	90,646	7,926.41	62	14,097.92
1920	847	423.20	79,198	6,585.71	65	13,977.76
Nevada:						
1916	13,330	2,681.38	721,211	116,039.39	65	17,139.89
1917	17,614	3,099.45	807,087	93,757.16	91	14,153.75
1918	14,384	3,157.77	839,879	82,026.71	54	10,564.13
1919	68,874	28,478.76	551,414	54,358.94	37	6,399.43
1920	76,863	24,216.14	619,572	62,968.62	39	7,383.91
Utah:						
1916	4,337	1,130.41	83,718	7,328.18	8	60.47
1917	25,318	4,864.68	124,011	10,851.33	3	5.42
1918	5	101.75	227,129	22,353.99	3	66.18
1919	14,618	3,489.71	224,517	20,198.11		
1920	24,837	10,209.30	266,164	23,053.69	3	21.91
Washington:						
1916			428	46.19	23	400.40
1917	48	30.89	533	43.41	17	283.86
1918			1,717	36.80	10	165.93
1919			3,438	65.02	7	60.32
1920			583	38.94	9	71.20

Nearly all the siliceous ore in three of the largest gold-producing States—Alaska, California, and South Dakota—yields only small value in silver and is classed as gold ore. The siliceous ores from Colorado include some silver and gold-silver ores, but the great bulk of the siliceous ore is purely gold ore.

Siliceous ore treated and gold recovered per ton of ore treated in 1913–1920.

Year.	Alaska.		California.		South Dakota.		Colorado.	
	Ore treated.	Recovery per ton.	Ore treated.	Recovery per ton.	Ore treated.	Recovery per ton.	Ore treated.	Recovery per ton.
	Short tons.	*Ounce.*	*Short tons.*	*Ounce.*	*Short tons.*	*Ounce.*	*Short tons.*	*Ounce.*
1913	1,614,506	0.144	2,031,429	0.267	1,899,139	0.187	2,161,458	0.378
1914	1,738,127	.135	2,050,797	.264	2,019,255	.175	2,157,762	.414
1915	3,020,607	.097	2,368,352	.272	1,889,970	.189	2,183,431	.464
1916	3,548,798	.081	2,192,078	.262	1,870,721	.193	2,057,452	.412
1917	3,414,664	.065	2,018,003	.246	1,867,859	.191	1,996,590	.347
1918	2,095,577	.080	1,538,960	.261	1,781,569	.178	1,760,222	.322
1919	3,262,573	.068	1,212,142	.339	1,330,349	.177	1,667,076	.258
1920	3,413,736	.063	788,136	.439	1,356,098	.167	1,224,081	.257

The quantity of siliceous ores treated in Alaska and South Dakota in 1920 increased, but the recovery of gold per ton was slightly less; the siliceous ore in California decreased about 424,000 tons, but the gold recovery per ton was the largest recorded for seven years.

COPPER ORES.

The gold obtained as a by-product in the smelting of copper ores sold or treated in 1920 showed a decrease in quantity but an increase in percentage of the total gold yield. The largest producer was Arizona, followed by Utah, Nevada, Montana, Oregon, and New Mexico.

LEAD ORES.

The gold in lead ores sold or treated in 1920 came chiefly from Utah, Colorado, and Arizona, and showed an increase over the output in 1919.

LEAD-ZINC, ZINC, AND MIXED ORES.

The production of gold from lead-zinc ores in 1920 decreased, and that from zinc ores, and copper-lead, and copper-lead-zinc ores increased. Utah, Colorado, and Montana produced nearly all the gold from lead-zinc ores and Montana nearly all the gold from zinc ores. Nevada, Colorado, and Utah contributed nearly all the gold from copper-lead ore.

DISTRIBUTION OF MINE PRODUCTION OF SILVER IN 1920, BY SOURCES.

Mine production of silver in 1920, in fine ounces.

State or Territory.	Placers.	Dry and siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama and Georgia	.....	10	.....	.....	.....	193	.....	203
Alaska	25,221	246,292	682,033	.....	.....	.....	.....	953,546
Arizona	15	1,051,982	3,716,246	521,441	.....	65,619	.....	5,355,303
California	29,900	1,243,971	179,752	252,704	.....	.....	.....	1,706,327
Colorado	6,716	3,637,318	100,643	841,783	88,837	7,566	726,472	5,409,335
Idaho	1,119	91,752	52,029	6,091,408	2,870	225,181	862,435	7,326,794
Illinois [a]	.....	.....	.....	8,193	.....	.....	.....	8,193
Massachusetts and Pennsylvania	.....	.....	90	1,160	.....	.....	.....	1,250
Michigan	.....	.....	470,189	.....	.....	.....	.....	470,189
Missouri	.....	.....	.....	82,464	.....	28,664	.....	111,128
Montana	2,210	2,000,162	6,030,507	800,856	1,166,634	47,124	2,531,685	12,579,178
Nevada	3,296	6,939,579	82,977	520,971	.....	114,358	83,912	7,745,093
New Mexico	20	608,657	104,814	47,140	.....	5,655	1,756	768,042
North Carolina and South Carolina	5	6	.....	.....	.....	.....	.....	11
Oregon	4,853	59,000	18,890	.....	.....	.....	.....	82,743
South Dakota	5	88,534	.....	2,256	.....	.....	.....	90,795
Tennessee	.....	.....	110,719	.....	.....	.....	.....	110,719
Texas	.....	508,601	2,800	.....	.....	.....	.....	511,401
Utah	7	3,955,771	452,915	7,895,007	.....	172,401	630,875	13,106,976
Washington	16	45,977	146,820	4,123	.....	2,742	.....	199,678
Total, 1920 [b]	73,383	20,477,612	12,151,424	17,069,506	1,258,341	669,503	4,837,135	56,536,904
Value	$79,987	$22,320,597	$13,245,052	$18,605,761	$1,371,591	$729,758	$5,272,477	$61,625,223
Percentage of total	0.13	36.22	21.49	30.19	2.23	1.18	8.56	100.00
Total, 1919 [b]	78,401	19,043,515	12,880,624	14,351,293	39,480	232,157	5,273,990	51,899,460
Value	$87,809	$21,328,736	$14,426,299	$16,073,448	$44,218	$260,016	$5,906,869	$58,127,395
Percentage of total	0.15	36.69	24.82	27.65	0.08	0.45	10.16	100.00

[a] Fluorspar-lead ores.

[b] Philippine Islands not included.

The mine production of silver from the three most important sources of silver—dry and siliceous ores, copper ores, and lead ores—was 87.90 per cent of the total output in 1920, against 89.16 per cent in 1919. The percentage of the total output from dry and siliceous ores decreased 0.47 per cent in 1920, following an increase of 5.01 per cent in 1919; that from lead ores increased 2.54 per cent, that from lead-zinc ores decreased 1.60 per cent, and that from copper ores 3.33 per cent. The combined yield of silver from placer bullion, zinc ores, and copper-lead ores was only 3.54 per cent of the total.

PLACERS.

The output of silver from the refining of placer gold was less than in 1919 or 1918. Of the total production 75 per cent came from Alaska and California.

DRY AND SILICEOUS ORES.

About 34 per cent of the mine production of silver from dry and siliceous ores was from Nevada (chiefly from the Tonopah district), 19 per cent from Utah (mainly from the Tintic district), and nearly 18 per cent from Colorado. There were increases in the quantity of silver from siliceous ores in many of the States, especially in California, Nevada, Utah, Montana, Alaska, and New Mexico. More than 99 per cent of the silver produced in Texas came from siliceous silver ores.

A large part of the silver from gold-silver siliceous ores is obtained with the gold by amalgamation and cyanidation in the mills, and the silver is then recovered by refining the mill bullion. The remainder is produced by smelting the richer ores and refining the copper or lead bullion produced. A small quantity of silver was also recovered from the leaching of copper ores.

COPPER ORES.

The silver produced from copper ores is obtained in the electrolytic refining of Lake and blister copper produced by smelting. The copper ores are mainly sulphides (except the Lake ores of Michigan, which are native metal in amygdaloid and conglomerate matrix), and a greater quantity contains chalcocite than chalcopyrite or cupriferous pyrite. The silver tenor of the extensive disseminated deposits of the Santa Rita district, N. Mex., and of Ely, Nev., is notably low, but similar deposits elsewhere add considerable quantities of silver.

In output of silver from copper ores Montana continued to lead with 6,030,507 ounces in 1920, against 6,341,825 ounces in 1919. Arizona was next with 3,716,246 ounces in 1920, against 3,711,052 ounces in 1919; Alaska ranked third, with 682,033 ounces in 1920, against 488,034 ounces in 1919; and California produced only 179,752 ounces in 1920, against 349,480 ounces in 1919. The production of Montana comes mainly from Butte, that of Arizona chiefly from Bisbee and Jerome, that of Utah from Tintic and Bingham, and that of California from Plumas County. Of these districts Bisbee well represents the disseminated type; Bingham produces from both lode and disseminated deposits; and the remainder produce silver chiefly from copper ore mined from deep lodes.

LEAD ORES.

The mine production of silver from argentiferous lead ores increased considerably in 1920 but did not equal that of 1918 (18,291,243 ounces). The output from Idaho increased 1,334,149 ounces, that of Utah increased 1,230,788 ounces, and that of Colorado decreased 226,577 ounces. The yield in Idaho is derived mainly from the silver-lead ores of the Coeur d'Alene district, that in Utah chiefly from the Park City and Tintic districts, and that in Colorado from Aspen and Leadville. The production of silver from lead ores increased also in Nevada, California, Arizona, Montana, and Missouri. Most of the output is obtained from the desilverization of lead bullion from smelting of western ores and concentrates.

ZINC, LEAD-ZINC, AND MIXED ORES.

Silver from argentiferous zinc ores increased greatly in 1920. It was mainly refinery by-product from the smelting of zinc concentrates from Montana.

Silver from lead-zinc ores decreased. It came chiefly from Colorado, from concentrates from the Coeur d'Alene region in Idaho, the Butte district in Montana, and the Park City region in Utah. The output from Idaho increased from 493,027 ounces in 1919 to 862,435 ounces in 1920, that in Montana decreased from 3,678,353 ounces to 2,531,685 ounces, and that in Utah decreased from 714,480 ounces to 630,875 ounces.

The output of silver from copper-lead and copper-lead-zinc ores came mainly from Idaho, Utah, Nevada, and Arizona.

PRODUCTION OF SILVER, BY SOURCES, 1905-1920.

Silver produced in the United States, by sources, as reported by mines, 1905–1920, in fine ounces.[a]

Year.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
1905....	112,826	17,187,889	15,762,947	16,070,203	939,252	5,416,723	782,656	56,272,496
1906....	171,058	16,792,799	15,880,870	15,328,653	98,423	6,815,678	2,274,972	57,362,453
1907....	126,808	19,038,042	13,955,436	17,318,811	93,419	489,825	1,474,725	52,497,066
1908....	159,285	19,862,038	14,945,189	14,049,481	37,605	1,099,283	722,906	50,875,787
1909....	152,040	19,826,890	18,300,705	17,027,737	313,948	549,923	1,141,434	57,312,677
1910....	159,381	23,125,042	16,024,543	15,028,076	755,369	535,987	1,968,311	57,596,709
1911....	170,084	25,205,749	16,759,638	15,596,638	630,573	285,006	2,460,152	61,107,840
1912....	163,955	26,363,436	18,744,661	16,632,377	664,421	654,596	2,810,939	66,034,385
1913....	123,739	28,010,875	18,250,253	18,629,246	86,432	752,563	5,334,120	71,187,228
1914....	152,128	27,812,335	14,829,828	19,302,081	145,264	248,866	7,132,747	69,623,249
1915....	154,968	25,709,505	18,781,365	19,828,533	1,136,220	234,047	6,509,092	72,353,730
1916....	126,351	24,593,656	24,541,234	19,216,586	1,274,292	533,273	8,572,141	78,857,533
1917....	118,604	21,489,465	20,314,233	19,096,474	549,656	448,042	8,645,038	70,661,512
1918....	89,494	21,564,982	20,462,597	18,291,243	135,676	224,580	7,290,380	68,058,952
1919....	78,401	19,043,515	12,880,624	14,351,293	39,480	232,157	5,273,990	51,899,460
1920....	73,383	20,477,612	12,151,424	17,069,506	1,258,341	669,503	4,837,135	56,536,904
	2,132,505	356,103,830	272,585,547	272,836,938	8,158,371	19,190,052	67,230,738	998,237,981

[a] Philippine Islands excluded.

The production of silver as reported by the mines had increased from 50,875,787 fine ounces in 1908 to 78,857,533 ounces in 1916. A decline during the next three years was followed by partial recovery in 1920, when the output was about 22,320,600 ounces less than it was

in 1916. The recovery from dry and siliceous ores was greatest in 1913, when the yield from the Tonopah mines was at its zenith and the production was about 7,533,000 ounces more than it was in 1920. The yield of silver from copper ores in 1920 was less than half the yield in 1916, when it reached the maximum. The combined production of silver from lead and lead-zinc ores increased from 19,625,283 ounces in 1919 to 21,906,641 ounces in 1920.

DISTRIBUTION OF PRODUCTION OF GOLD AND SILVER, BY METHODS OF TREATMENT.

SUMMARY OF DISTRIBUTION.

In the following table is given the recoverable gold and silver content of the ore, tailings, and slag treated.

Distribution of gold and silver produced in 1920, by States.[a]

State or Territory.	Total quantity of crude ore, tailings, and slag treated or sold in 1920.	Ore to gold and silver mills.			Crude ore.			
		Quantity.	Gold in bullion.	Silver in bullion.	To concentrating mills, quantity.	Concentrates produced from all sources.		
						Quantity.	Gold.	Silver.
	Short tons.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Short tons.*	*Short tons.*	*Fine ounces.*	*Fine ounces.*
Alaska	4,178,761	3,113,752	146,948	32,790	1,031,463	83,189	68,449	571,976
Arizona	14,920,478	203,046	[b] 139,002	[b] 129,671	10,296,849	635,817	18,902	1,125,502
California	1,165,022	721,180	290,980	105,626	378,526	38,071	44,597	221,560
Colorado	1,571,293	626,900	223,363	138,307	677,113	119,233	72,306	2,406,336
Idaho	1,958,401	38,570	10,767	3,664	1,643,902	276,955	4,644	5,457,724
Montana	5,241,615	78,443	[c] 25,822	[c] 37,255	3,273,347	1,045,923	27,839	8,969,000
Nevada	3,480,620	648,871	[d] 124,692	[d] 6,259,878	2,622,053	367,107	24,093	301,077
New Mexico	2,250,718	49,393	9,749	271,294	2,118,694	180,022	4,823	139,161
Oregon	82,156	34,856	13,015	36,597	46,333	8,011	12,417	33,860
South Dakota	1,356,189	1,356,079	226,081	87,319	.....	.....	.....	.....
Texas	56,269	56,042	.....	508,601	.....	.....	.....	.....
Utah	6,800,180	23,696	4,234	122,797	5,895,665	424,220	46,637	2,191,040
Washington	85,318	12	21	3	61,639	4,106	224	99,411
Eastern or Appalachian States [e]	591,171	620	37	16	640	50	27	283
	43,738,191	6,951,460	1,214,711	7,733,818	28,046,224	3,182,704	324,958	21,516,930
Total, 1919	41,020,722	7,775,811	1,418,875	7,281,638	25,906,908	3,033,711	360,155	19,363,037

State or Territory.	Crude ore to smelters.			Old tailings and slag treated.		
	Quantity.	Gold.	Silver.	Quantity.	Gold.	Silver.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*	*Fine ounces.*	*Fine ounces.*
Alaska	33,546	1,931	323,559	.....	.....	.....
Arizona	2,441,591	73,286	4,070,064	1,978,992	118	30,051
California	31,776	12,726	1,325,661	33,540	2,437	23,580
Colorado	267,280	45,942	2,857,976	.....	.....	.....
Idaho	101,986	2,574	1,864,287	173,943	.....	.....
Montana	182,071	19,463	2,816,962	1,707,754	2,448	753,751
Nevada	171,573	15,523	1,158,332	38,123	848	22,510
New Mexico	82,631	8,557	357,567	.....	.....	.....
Oregon	967	1,966	7,433	.....	.....	.....
South Dakota	110	115	3,471	.....	.....	.....
Texas	227	.....	2,800	.....	.....	.....
Utah	611,346	45,626	10,338,616	269,473	935	454,516
Washington	23,667	5,530	100,248	.....	.....	.....
Eastern or Appalachian States	589,911	291	111,879	.....	.....	.....
	4,538,682	233,530	25,338,855	4,201,825	6,786	1,284,408
Total, 1919	4,646,019	261,309	23,739,621	2,691,984	8,565	900,492

[a] Exclusive of small quantity of silver from copper ores in Michigan and Missouri and from lead ores in Illinois and Missouri, and of gold and silver from the Philippine Islands.
[b] Includes recoveries from 5,489 tons of old tailings.
[c] Includes recoveries from 10,545 tons of old tailings.
[d] Includes recoveries from 33,520 tons of old tailings.
[e] Copper, zinc, and zinc-lead ores containing no silver excluded.

The first item takes no account of placer gravel but represents output of mines producing ore only. The greatest output was from Arizona, Utah, Montana, Nevada, and New Mexico—all notable for large yield of copper ores—and from Alaska.

Many gold and silver mills employ concentrating apparatus, and the concentrates they obtain are combined in the table with those from straight concentrating mills under the heading "Concentrates produced." The gold and silver included in this item is recovered mainly by amalgamation and cyanidation, as is shown in detail in the last table of this report.

The figures for the quantity of ore treated by concentration only include the large quantities of copper, lead, zinc, and mixed ores whose concentrates are smelted primarily for these metals, the gold and silver being recovered in refining the copper and lead bullion and smelting the zinc residues. Examples are the copper ores of the disseminated deposits of Bingham, Utah, and of New Mexico and Nevada; the copper ores of Butte, Mont.; and the lead and lead-zinc ores of Coeur d'Alene, Idaho, Butte, Mont., and Leadville, Colo. The quantity of concentrates produced and the recoverable gold and silver content represent not only the concentrates from these straight concentrating mills but also those from gold and silver mills, which form, however, a very small part of the total quantity of concentrates and are derived mainly from Alaska, California, and Colorado ores. These concentrates are mainly smelted but are also treated in gold and silver mills by the processes named.

The ore treated in straight concentration mills increased notably in 1920, mainly because of more activity at copper mines in Montana, Arizona, and other States. Montana mills produced the largest quantity of concentrates, followed by those of Arizona, Utah, Nevada, Idaho, and New Mexico. The recoverable gold content of concentrates came mainly from Colorado, Alaska, Utah, California, Montana, and Nevada. About 67 per cent of the recoverable silver from concentrates produced came from Montana and Idaho; and large quantities came from Colorado, Utah, Arizona, Alaska, and Nevada. The increase was due largely to an increase in the silver in concentrates derived from ores mined in Idaho, Utah, and Colorado.

The quantity and the recoverable precious-metal content of crude ores shipped from the mines direct to the smelters in general include the richer gold, silver, copper, lead, and mixed ores from which the gold and silver is eventually recovered by refining the copper or lead bullion that collects the precious metals in the smelting. Arizona produced more than 53 per cent of the ore directly smelted and was followed by Utah, Tennessee, Colorado, Montana, and Nevada. Utah and Arizona produced nearly 57 per cent of the silver recovered from crude ore smelted.

The old materials, principally tailings and slags, re-treated (with which are included ore and tailings leached) are partly smelted, often for their fluxing as well as their metal value; but considerable quantities of old tailings are now concentrated and cyanided, and the impounding of mill tailings for future treatment as well as because of legal requirements has become a general practice. The increase in quantity of old material treated in 1920 was due mainly to the treatment of old slag and tailings in Arizona and Montana. Most of the gold and silver derived from old tailings is included under

recoveries by amalgamation and cyanidation at gold and silver mills. The total quantity of ore leached in 1920 was 3,432,866 short tons, of which 1,968,839 tons was from Arizona mines, 204,422 from Utah mines, 1,259,255 tons from Montana mines, and 350 tons from Nevada mines.

PERCENTAGE PRODUCED BY DIFFERENT PROCESSES.

Percentage of output of gold and silver produced by different processes, 1916–1920.

Process.	Gold.					Silver.				
	1916	1917	1918	1919	1920	1916	1917	1918	1919	1920
Placers	25.0	25.8	23.6	25.6	25.3	0.2	0.2	0.13	0.15	0.13
Gold and silver mills:										
By amalgamation	21.5	20.9	20.7	31.5	28.5	.4	.4	.3	.5	.4
By cyanidation	28.1	29.5	32.0	28.5	24.3	18.3	16.3	14.3	13.8	13.4
By chlorination	.5	.2	.2	.....	.....	.....	.....	.....	.....	.....
Total milling	50.1	50.6	52.9	60.0	52.8	18.7	16.7	14.6	14.3	13.8
Smelting [a]	24.9	23.6	23.5	14.4	21.9	81.1	83.1	85.3	85.55	86.07
Total [b]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] Both crude ore and concentrates. [b] Philippine Islands and Porto Rico excluded.

The dredges produced about $1,060,000 less gold in 1920 than in 1919, and the combined placer yield from hydraulic, drift, and other surface methods was about $1,035,900 less than in 1919. The decrease from placers was largely due to a decrease of 53,000 ounces in Alaska and 47,000 ounces in California. The percentage of output of silver credited to the placers is insignificant.

In the mills the proportion of gold recovered by the amalgamation process showed a loss of 3 per cent in 1920. The proportion of gold recovered by cyanidation showed a decrease of 4.2 per cent, following a decrease of 3.5 per cent in 1919. Colorado, Arizona, Nevada, South Dakota, and California ores yielded the larger part of the gold recovered by cyanidation, and the decrease was due to much smaller recoveries by the cyanide process in Colorado and Nevada. The chlorination process was not used in California in 1919 or 1920.

GOLD AND SILVER PRODUCED AT MILLS, BY STATES.

A large quantity of concentrates from sulphide ores is now smelted and the increased application of the flotation process has resulted in decreased yield of gold and silver from cyanidation, as nearly all such concentrates are shipped to smelters.

The smelters, which had for two years been producing a slightly greater proportion of gold and silver, are to be credited in 1920 with about 22 per cent of the total output of gold and 86 per cent of the silver.

The bulk of the gold produced continues to come from the gold mills. As shown in the table, the proportion of gold recovered by amalgamation and cyanidation has increased from 50.1 per cent in 1916 to 52.8 per cent in 1920.

Gold and silver produced at mills in 1920, by States.[a]

State.	Ore and tailings treated (short tons).	Bullion recovered (fine ounces).				Percentage of gold and silver from all sources.			
		Amalgamation.		Cyanidation.		Amalgamation.		Cyanidation.	
		Gold.	Silver.	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.
Alaska	3,411,951	146,925	32,790	27,407	3,872	36.3	3.4	6.8	0.4
Arizona	208,535	1,343	460	137,659	129,211	.6	.....	59.5	2.4
California	754,720	260,393	108,393	48,959	65,072	37.6	6.4	7.1	3.8
Colorado	[b] 852,510	83,678	18,861	137,987	118,815	22.8	.3	37.6	2.2
Idaho	38,570	10,556	3,282	211	382	44.9	.....	.9	.....
Montana	88,988	3,462	2,033	22,360	35,222	3.9	.....	25.0	.3
Nevada	682,391	17,611	12,554	107,081	6,247,324	10.2	.2	62.1	80.7
New Mexico	49,393	4,284	700	5,465	270,594	18.4	.1	23.5	35.2
Oregon	36,536	3,096	6,853	10,764	36,011	6.3	8.3	21.9	43.5
South Dakota	[c] 1,356,079	148,018	42,863	78,063	44,456	65.4	47.2	34.5	49.0
Texas	56,042	.....	.....	.....	508,601	.....	.....	.....	99.5
Utah	23,696	6	2	4,228	122,795	.....	.....	4.3	.9
Washington	12	.....	.....	21	3	.....	.....	.4	.....
Appalachian States	620	37	16	.....	.....	9.0	.....	.....	.....
Total, 1920	7,560,043	679,409	228,807	580,205	7,582,358	28.5	.4	24.3	13.4
Value	.....	$14,044,610	$249,400	$11,993,902	$8,264,770	.....	.....	.....	.....
Total, 1919	8,668,507	839,761	279,793	685,330	7,163,726	31.5	.5	28.5	13.8
Value	.....	$17,359,400	$313,368	$14,167,028	$8,023,373	.....	.....	.....	.....

[a] Philippine Islands excluded.
[b] Part of ore amalgamated followed by cyanidation of new tailings—total ore and tailings cyanided 473,162 tons.
[c] Also 1,245,419 tons of tailings from ore amalgamated was treated.

Figures corresponding to those in this table have been published for the entire United States by the Geological Survey since 1911. The quantity of crude ore treated and old and new tailings re-treated in gold and silver mills reached a maximum in 1915 (11,878,287 tons). It exceeded 11,000,000 tons in 1916 and 1917 but has declined steadily since the record year, except for a small increase in 1919.

The great bulk of the ore treated was milled in Alaska, Colorado, South Dakota, California, Nevada, and Arizona, and here the famous mines and mills of the Homestake, Mother Lode, Grass Valley, Treadwell, Cripple Creek, Tonopah, Goldfield, and San Francisco (Oatman) districts are especially noteworthy. Large numbers of smaller mills, however, mark the wide distribution of gold mining in these regions and in many other scattered districts.

The total yield of gold by amalgamation in the United States in 1920 was 679,409 fine ounces, against 839,761 fine ounces in 1919, and there has been a decrease of about 285,200 ounces since 1916. Appreciable decreases were shown in Colorado, California, Alaska, and Nevada, and there were small increases in Oregon and South Dakota.

The silver produced by amalgamation came mainly from California, South Dakota, Alaska, Colorado, and Nevada, and consisted chiefly of silver alloyed with gold.

The output of gold by cyanidation decreased 105,125 ounces. It was derived mainly from Colorado, Arizona, Nevada, South Dakota, California, and Alaska. The principal decreases were in Colorado, 69,321 ounces; Nevada, 32,983 ounces; and Montana, 10,465 ounces.

Nevada led in yield of silver by cyanidation and was followed by Texas, New Mexico, and Arizona. The most notable loss was in

Colorado, 96,076 ounces. The only gains of any size were 663,316 ounces in Nevada and 58,346 ounces in Utah.

Of the gold-producing States whose output is derived chiefly from milling ores, Alaska, California, Idaho, and South Dakota still yield more gold by amalgamation than by cyanidation, but cyanidation produces more gold than amalgamation in Arizona, Colorado, Montana, Nevada, and Oregon, and it produces much more silver in Arizona, Colorado, Montana, Nevada, New Mexico, Oregon, Texas, and Utah. Only in Alaska, California, and Idaho did the recovery of silver by amalgamation exceed that by cyanidation. Altogether amalgamation produced gold and silver valued at $14,294,010 from milling ores in 1920, against $20,258,672 produced by cyanidation.

QUICKSILVER AND POTASSIUM AND SODIUM CYANIDE CONSUMED IN CERTAIN STATES.

For details of the consumption of quicksilver in the amalgamation milling process and of potassium cyanide and sodium cyanide in the cyanidation process the reader is referred to the mines reports of the several Western States. The consumption of quicksilver at mills treating ore and by dredging and other methods of placer mining is given in the separate chapters on quicksilver in 1917, 1918, 1919, and 1920 in Mineral Resources.

The following tables were compiled by V. C. Heikes:

Quicksilver consumed in certain Western States, 1916–1920.

State and year.	Number of mills using quicksilver.	Ore and tailings treated.	Total quicksilver.[a]	Quicksilver consumed (average per ounce of gold and silver bullion).
Arizona:		*Short tons.*	*Pounds.*	*Pound.*
1916	13	17,568	645.00	0.040
1917	9	21,100	205.00	.057
1918	7	1,389	17.00	.012
1919	6	2,374	33.00	.077
1920	4	1,688	56.00	.031
Idaho:				
1916	36	66,304	1,183.00	.039
1917	27	63,884	1,035.00	.032
1918	22	31,263	953.00	.057
1919	12	40,504	828.00	.0406
1920	9	38,556	737.00	.053
Montana:				
1916	18	18,959	206.00	.026
1917	13	8,925	167.00	.040
1918	13	6,492	99.00	.053
1919	17	13,142	178.00	.054
1920	11	27,989	250.00	.046
Nevada:				
1916	36	131,891	2,111.00	.034
1917	32	67,359	839.00	.020
1918	34	54,048	675.00	.017
1919	21	60,038	1,149.00	.026
1920	21	41,700	631.00	.021
Utah:				
1916	4	703	15.00	.039
1917	2	190	5.00	.030
1918	2	112	2.00	.018
1919				
1920				
Washington:				
1916	5	11,495	317.00	.027
1917	4	10,976	185.00	.026
1918	1	960	20.00	.038
1919				
1920				

[a] Partly estimated.

Quicksilver consumed in certain Western States, 1916–1920—Continued.

State.	1916	1917	1918	1919	1920
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Arizona	645	205	17	33	56
Idaho	1,183	1,035	953	828	737
Montana	206	167	99	178	250
Nevada	2,111	839	675	1,149	631
Utah	15	5	2	.....	.....
Washington	317	185	20	.....	.....
	4,477	2,436	1,766	2,188	1,674

Quicksilver consumed in Colorado in 1920 amounted to 2,464 pounds, in New Mexico to 127 pounds, and in South Dakota to 8,660 pounds.

Potassium and sodium cyanides consumed in certain Western States, 1916–1920.

State and year.	Number of mills using cyanidation process.	Ore and tailings treated.	Total consumption of cyanide.[a]	Cyanide consumed.	
				Average per ton of ore and tailings.	Average per ounce of gold and silver.
Arizona:		*Short tons.*	*Pounds.*	*Pounds.*	*Pounds.*
1916	9	276,623	216,841	0.780	0.300
1917	10	227,648	157,961	.69	.430
1918	10	221,508	157,829	.71	.53
1919	8	211,199	117,489	.56	.49
1920	4	206,847	227,369	1.10	.85
Idaho:					
1916	8	3,469	4,631	1.33	.38
1917	4	3,793	4,996	1.30	.45
1918	4	9,582	15,600	1.63	4.45
1919	3	907	950	1.05	2.07
1920	1	334	1,600	4.79	2.70
Montana:					
1916	18	381,560	203,554	.53	.69
1917	15	328,685	158,215	.48	.53
1918	14	190,119	83,542	.44	.53
1919	11	97,802	64,900	.66	.55
1920	8	60,999	105,874	1.74	1.84
Nevada:					
1916	33	1,367,249	2,320,328	1.70	.20
1917	32	1,203,665	1,925,168	1.60	.20
1918	33	1,220,879	1,765,010	1.45	.21
1919	30	614,190	1,043,111	1.70	.182
1920	33	640,690	1,672,190	2.61	.263
Utah:					
1916	2	720	1,200	1.67	4.48
1917	.....	.....	.....	.....	.....
1918	1	900	2,700	3.00	.63
1919	1	14,571	37,844	2.597	.566
1920	1	23,682	40,599	1.71	.32
Washington:					
1916	1	1,207	2,380	1.97	3.12
1917	.....	.....	.....	.....	.....
1918	.....	.....	.....	.....	.....
1919	.....	.....	.....	.....	.....
1920	1	8	25	3.13	1.09

[a] Partly estimated.

Sodium cyanide consumed in certain Western States, 1916–1920, in pounds.[a]

State.	1916	1917	1918	1919	1920
Arizona	216,841	157,381	157,204	99,605	219,569
Colorado	1,082,617	746,428	779,741	582,547	338,763
Idaho	700	3,728	15,600	950	1,600
Montana	190,249	158,215	83,542	64,900	105,874
Nevada	2,179,995	1,925,038	1,765,010	992,840	1,672,190
New Mexico	176,525	123,500	79,065	108,805	90,200
South Dakota	419,210	384,938	370,218	284,653	[b]365,095
Texas	45,100	37,000	63,130	38,700	36,976
Utah	.....	37,000	2,700	37,844	40,599
Washington	2,380	.....	.....	.....	.....
	4,313,617	3,573,228	3,316,210	2,210,844	2,870,866

[a] The consumption of potassium cyanide was 185,764 pounds in 1916, 137,658 pounds in 1917, 625 pounds in 1918, 68,155 pounds in 1919 (17,884 pounds at mills in Arizona and 50,271 pounds at mills in Nevada), and 7,825 pounds in 1920 (7,800 pounds at mills in Arizona and 25 pounds at mills in Washington).
[b] Includes some cyanamid.

It has not been possible to obtain figures showing the total consumption of potassium cyanide and sodium cyanide used in the recovery of gold and silver in the United States in 1920. If the quantity used in California, Alaska, and Oregon is added to the 2,878,691 pounds reported to have been used in other Western States the total consumption was probably about 3,300,000 pounds.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO.

(MINES REPORT.)

By Charles W. Henderson.

PRODUCTION.

The total value of gold, silver, copper, lead, and zinc produced in New Mexico from ores and gravels in 1920 increased nearly 5 per cent compared with 1919. There were 99 producing mines, of which 93 were deep and 6 were placer, an increase of 7 deep mines but no change in the number of placers.

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1919–20.

Year.	Ore.	Gold.[a]	Silver.[a]	Copper.	Lead.	Zinc.	Total value.
	Short tons.		*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	2,155,998	$655,656	837,418	51,150,541	2,886,513	7,594,644	$11,814,958
1920	2,250,718	480,302	768,042	54,400,691	2,869,525	10,013,580	12,367,857
Increase or decrease, 1920	+94,720	−175,354	−69,376	+3,250,150	−16,988	+2,418,936	+552,899

[a] Includes placer production.

ORE.

The bullion derived from 49,393 tons of ore treated in 1920 at amalgamating and cyaniding mills in New Mexico amounted to $201,531 in gold, or $4.08 a ton, and 271,294 ounces of silver, valued at $295,710, or 5.49 ounces and $5.99 a ton. The recovery as bullion per ton of ore treated in 1919 was $5.01 in gold and $4.85 in silver.

GOLD.

The recoverable output of gold from New Mexico ores and gravels in 1920 amounted to 23,234.61 fine ounces, valued at $480,302. Colfax and Lincoln counties combined produced 18 per cent of the total, Grant County nearly 19 per cent, Hidalgo County 32 per cent, and Socorro County (entirely from the siliceous mines at Mogollon) 26 per cent. Dry and siliceous ores yielded about 72 per cent of the total. Copper ores contained 26 per cent, chiefly from the Central district, Grant County, and the Lordsburg district, Hidalgo County. Lead ores, chiefly from the Victorio district, Luna County, copper-lead and lead-zinc ores, and placers each furnished a small quantity of gold The production of placer gold amounted to $2,188.

SILVER.

The recoverable output of silver from New Mexico ores and gravels in 1920 amounted to 768,042 fine ounces, valued at $837,166. Of the total quantity Socorro County produced 45 per cent, chiefly from siliceous ore of the Mogollon district and in part from mixed ores of the Magdalena district; Grant County nearly 11 per cent, chiefly from the Burro Mountain, Central, and Gold Hill districts; and Hidalgo County 26 per cent, chiefly from the Lordsburg district. Only 20 ounces of silver was recovered from placer bullion.

Dry and siliceous gold and silver ore, chiefly from Hidalgo, Sierra, and Socorro counties, yielded more than 79 per cent of the total; copper ores, chiefly from Grant and Socorro counties, yielded more than 13 per cent; lead ores, chiefly from the Central district, Grant County, the Victorio district, Luna County, and the Magdalena district, Socorro County, yielded 6 per cent; copper-lead ores, chiefly from the Central district, Grant County, and the Magdalena district, Socorro County, and zinc-lead ores yielded a little less than 1 per cent. Zinc ores yielded no silver.

COPPER.

The mine production of copper in New Mexico in 1920 amounted to 54,400,691 pounds, valued at $10,009,727. Grant and Hidalgo counties combined, chiefly from the output of the Chino Copper Co., at Santa Rita, and from the Burro Mountain and Lordsburg districts, produced nearly 99 per cent of the total. Hidalgo County was set off from Grant County on January 1, 1920. There was an increase of 4,041,454 pounds in the Central district and of 504,567 pounds in the Burro Mountain district, and a decrease of 820,783 pounds in the Lordsburg district. The output from Dona Ana County decreased 150,470 pounds, from Socorro County 296,658 pounds, and from Sandoval County 46,179 pounds.

Copper ores, chiefly from Grant, Socorro, and Dona Ana counties, yielded nearly 97 per cent of the total; the yield from other classes of ore is shown in the table on page 551.

LEAD.

The mine production of lead in New Mexico in 1920 amounted to 2,869,525 pounds, valued at $229,562. The principal lead-producing districts were the Central district, Grant County; the Magdalena district, Socorro County; and the Victorio district, Luna County. Grant County produced 1,038,825 pounds, Socorro County 875,062 pounds, and Luna County 359,488 pounds. Lead ores produced nearly 80 per cent of the total; the production from other classes of ore is shown on page 551.

ZINC.

The total recoverable zinc, whether marketed as metal or as oxide from crude ore and concentrates, shipped from New Mexico in 1920 and calculated in terms of zinc as metal and zinc in the various forms of zinc oxide, was 10,013,580 pounds, valued at $811,100. The zinc ore and concentrates marketed in 1920 amounted to 17,281 short

tons, an increase of 4,916 tons, and the average assay was 36.21 per cent, a decrease of 2.14 per cent. The principal mines producing zinc were in the Magdalena district, Socorro County, and the Central district, Grant County.

OUTPUT OF ORE AND METAL CONTENT.

Ore and metals produced in New Mexico in 1920.

Source.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry gold ore	8,092	5,247.35	2,840	12,924	36,937	.....
Dry silver ore	53,353	6,203.09	501,653	112,627	56,126	.....
Dry gold and silver ore	40,442	5,177.74	104,164	1,704,180	.....	.....
Copper ore	2,090,711	5,992.17	104,814	52,462,145	67,541	.....
Copper-lead ore	294	9.92	5,655	29,289	52,189	.....
Lead ore	6,931	347.23	47,140	77,535	2,240,182	.....
Zinc-lead ore	4,249	151.27	1,756	1,991	394,750	1,009,432
Zinc ore	46,646	.....	.....	.....	21,800	9,004,148
	2,250,718	23,128.77	768,022	54,400,691	2,869,525	10,013,580
Placers	.....	105.84	20	.....	.....	.....
	2,250,718	23,234.61	768,042	54,400,691	2,869,525	10,013,580

Content of ores sold or treated in New Mexico in 1920.

Dry and siliceous gold and silver ores.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
GOLD ORES.					
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Colfax and Lincoln	6,137	4,152.12	620	.....	.....
Grant	1,322	566.13	1,233	5,837	36,937
Santa Fe	17	54.67	46	2,598	.....
Sierra	616	474.43	941	4,489	.....
	8,092	5,247.35	2,840	12,924	36,937
SILVER ORES.					
Dona Ana	10	.....	511	.....	513
Grant	874	13.75	14,054	2,360	2,275
Hidalgo	4,296	47.80	46,920	93,577	36,900
Sierra	6,010	64.14	108,657	10,385	2,013
Socorro	42,163	6,077.40	331,511	6,305	14,425
	53,353	6,203.09	501,653	112,627	56,126
GOLD AND SILVER ORES.					
Grant	800	130.81	1,822	.....	.....
Hidalgo	39,642	5,046.93	102,342	1,704,180	.....
	40,442	5,177.74	104,164	1,704,180	.....

Copper ores.

Dona Ana	986	.....	789	164,908	.....
Grant and Hidalgo	2,086,664	5 771.59	89,667	51,939,336	66,778
Luna	11	0.19	311	2,223	763
Sandoval	89	.....	700	53,821	.....
Sierra	78	218.50	2,147	12,245	.....
Socorro	2,875	.....	11,044	287,492	.....
Taos	8	1.89	156	2,120	.....
	2,090,711	5,992.17	104,814	52,462,145	67,541

Content of ores sold or treated in New Mexico in 1920—Continued.

Copper-lead ores.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
GOLD ORES.	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Grant	88	1.02	1,178	12,756	21,288
Sierra	206	8.90	4,477	16,533	30,901
	294	9.92	5,655	29,289	52,189

Lead ores.

Colfax and Lincoln	373	.....	1,389	11,386	175,250
Dona Ana	386	2.13	3,479	3,945	119,587
Grant	3,136	15.47	21,744	35,353	942,575
Hidalgo	340	4.11	3,049	6,588	107,596
Luna	1,429	322.52	11,300	1,641	357,925
Sandoval	21	.....	11	.....	5,262
Sierra	47	3.00	867	174	51,350
Socorro	1,199	.....	5,301	18,448	480,637
	6,931	347.23	47,140	77,535	2,240,182

Lead-zinc ores.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Grant	1,400	151.27	1,756	1,991	34,750	43,247
Socorro	2,849	.....	.....	.....	360,000	966,185
	4,249	151.27	1,756	1,991	394,750	1,009,432

Zinc ores.

Dona Ana	25	.....	.....	.....	.....	12,852
Grant	36,442	.....	.....	.....	1,000	6,134,593
Luna	41	.....	.....	.....	800	21,098
Santa Fe	94	.....	.....	.....	.....	37,555
Socorro	10,044	.....	.....	.....	20,000	2,798,050
	46,646	.....	.....	.....	21,800	9,004,148

SMELTERS.

The only smelter in operation in New Mexico in 1920 was the zinc oxide plant at Waldo, near Cerrillos. Smelters receiving ore from New Mexico were the lead and copper plants of the El Paso Smelting Works, at El Paso, Tex.; the Copper Queen copper smelter and the Calumet & Arizona copper smelter, at Douglas, Ariz.; the Ozark zinc-lead oxide plant, at Coffeyville, Kans.; and the various plants associated with the Empire Zinc Co.

MINING INDUSTRY.

The features of mining in New Mexico in 1920 were the continuation of operations of the Chino Copper Co.'s 12,000-ton mill at a rate equivalent to 5,022 tons a day; the resumption of milling at the Burro Mountain mill from August through December; the lessened production of the Eighty-Five mine, at Lordsburg; the decreased production of gold and silver in the Mogollon district; the decreased production of gold in the Baldy district; the small increase of zinc production in the Kelly and Central districts; and the increased production of gold and silver from Sierra County mines.

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1920.

County.	Number of mines producing.	Ore.	Gold [a]		Silver [a]	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Colfax and Lincoln [b]	7	6,510	4,231.16	$87,466	2,018	$2,200
Dona Ana	9	1,407	2.13	44	4,779	5,209
Grant	29	2,118,187	4,342.43	89,766	81,299	88,616
Hidalgo	13	56,817	7,433.25	153,659	202,477	220,700
Luna	8	1,481	322.71	6,671	11,611	12,656
Sandoval	2	110			711	775
Santa Fe	5	111	54.67	1,130	46	50
Sierra	17	6,957	768.97	15,896	117,089	127,627
Socorro	8	59,130	5,077.40	125,631	347,856	379,163
Taos	1	8	1.89	39	156	170
Total, 1919	99	2,250,718	23,234.61	480,302	768,042	837,166
	92	2,155,998	31,717.36	655,656	837,418	937,908
Increase or decrease, 1920	+7	+94,720	−8,482.75	−175,354	−69,376	−100,742

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Colfax and Lincoln [b]	11,386	$2,095	175,250	$14,020			$105,781
Dona Ana	168,853	31,069	120,100	9,608	12,852	$1,041	46,971
Grant	51,015,864	9,386,919	1,038,825	83,106	6,177,840	500,405	10,148,812
Hidalgo	2,786,114	512,645	211,274	16,902			903,906
Luna	3,864	711	359,488	28,759	21,098	1,709	50,506
Sandoval	53,821	9,903	5,262	421			11,099
Santa Fe	2,598	478			37,555	3,042	4,700
Sierra	43,826	8,064	84,264	6,741			158,328
Socorro	312,245	57,453	875,062	70,005	3,764,235	304,903	937,155
Taos	2,120	390					599
Total, 1919	54,400,691	10,009,727	2,869,525	229,562	10,013,580	811,100	12,367,857
	51,150,541	9,514,000	2,886,513	152,985	7,594,644	554,409	11,814,958
Increase or decrease	+3,250,150	+495,727	−16,988	+76,577	+2,418,936	+256,691	+552,899

[a] Includes placer production.
[b] In order to avoid disclosing individual figures, the production of Colfax and Lincoln counties is combined.

Gold and silver produced at mills in New Mexico, 1919–20.

Year.	Ore to gold and silver mills.	Gold in bullion.	Silver in bullion.	Ore to concentrating mills.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
1919	74,167	17,990.07	321,303	1,987,943
1920	49,393	9,749.05	271,294	2,118,694
Increase or decrease, 1920	−24,774	−8,241.02	−50,009	+130,751

Mine production of metals from New Mexico concentrates, 1919–20.

Year.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
1919	155,136	4,655.34	179,760	46,240,975	9,534	3,228,834
1920	180,022	4,823.11	139,161	50,581,980	81,950	7,543,803
Increase or decrease, 1920	+24,886	+167.77	−40,599	+4,341,005	+72,416	+4,314,969

Mine production of metals from New Mexico crude ore shipped to smelters, 1919–20.

Year.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
1919	93,888	8,832.06	336,322	4,909,566	2,876,979	4,365,810
1920	82,631	8,556.61	357,567	3,818,711	2,787,575	2,469,777
Increase or decrease, 1920	−11,257	−275.45	+21,245	−1,090,855	−89,404	−1,896,033

Mine production of metals from New Mexico crude ore and concentrates combined, shipped to smelters, 1919–20.

Year.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
1919	249,024	13,487.40	516,082	51,150,541	2,886,513	7,594,644
1920	262,653	13,379.72	496,728	54,400,691	2,869,525	10,013,580
Increase or decrease, 1920	+13,629	−107.68	−19,354	+3,250,150	−16,988	+2,418,936

Mine production of metals from New Mexico crude ore shipped to smelters, 1920.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Colfax and Lincoln	373	.....	1,389	11,386	175,250	.....
Dona Ana	1,407	2.13	4,779	168,853	120,100	12,852
Grant	9,843	271.15	36,997	447,427	965,538	467,429
Hidalgo	53,917	7,433.25	175,099	2,781,674	204,661	.....
Luna	1,481	322.71	11,611	3,864	359,488	21,098
Sandoval	110	.....	711	53,821	5,262	.....
Santa Fe	111	25.41	44	2,598	.....	37,555
Sierra	6,207	500.07	108,414	35,305	84,264	.....
Socorro	9,174	.....	18,367	311,663	873,012	1,930,843
Taos	8	1.89	156	2,120	.....	.....
	82,631	8,556.61	357,567	3,818,711	2,787,575	2,469,777

Gold and silver contained in bullion produced at mills in New Mexico, 1920.

Process.	Ore.	Gold in bullion.	Silver in bullion.	Quicksilver used.	Sodium cyanide used.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Amalgamation	6,698	4,284.34	700	127	.....
Cyanidation	42,695	5,464.71	270,594	.....	90,200
	49,393	9,749.05	271,294	127	90,200

REVIEW BY COUNTIES.

BERNALILLO COUNTY.

Assessment work was done on prospects in the Coyote, Hell Canyon, and Soda Springs districts.

COLFAX COUNTY.

Elizabethtown district (including Baldy).—Mining and milling was continuous at the Aztec mine, at Baldy, only to June. Operations for the remainder of the year were confined to development work.

A small bar of gold bullion was recovered from experiments in the treatment of ore from the Ajax mine, on Willow Creek. The Lowrey placer, at Elizabethtown, and placer ground on Willow Creek were worked during the year with excellent results for the time and labor expended. Development work was continuous at the Klondike mine, in the West Moreno district.

DONA ANA COUNTY.

Lessees on the Torpedo mine, in the Organ Mountain district, shipped a considerable quantity of ore that was low in silver but had a good commercial content of copper. Lessees shipped several hundred tons of lead-silver ore from the Bennett-Stephenson mine. Several cars of lead and copper ores were shipped by other lessees in the district.

GRANT COUNTY.

Black Hawk district.—Several cars of silver ore were shipped from the Black Hawk district.

Burro Mountain district.—The Burro Mountain Branch of the Phelps Dodge Corporation confined its operations to mine development from January through July and operated steadily its 2,000-ton gravity-concentration and oil-flotation mill from August through December. Lessees on this property shipped a few cars of oxidized copper ore. Several cars of silver ore were shipped from the Cora Mitchell mine.

Central district.—The output from 10 mines of the Central district, embracing the towns of Bayard, Fierro, Georgetown, Hanover, and Santa Rita, was 1,882,172 tons of ore, yielding $68,962 in gold, 26,190 ounces of silver, 44,400,088 pounds of copper, 925,513 pounds of lead, and 6,134,593 pounds of zinc, with a total value of $8,838,068, as compared with $7,984,543 in 1919. This district remained the most productive in New Mexico.

A considerable quantity of oxidized lead-silver ore was shipped from the Lucky Bill mine, several hundred tons of copper sulphide ore from the Dewey-Schley, several cars of zinc carbonate ore from the Bond-Pewabic, several cars of lead-copper ore from the Groundhog, a car of lead-silver ore from the Georgetown, a car of silver ore from the Refugee, and several cars of zinc sulphide ore from the Republic.

The Empire Zinc Co. shipped zinc carbonate ores from its Hanover mines and also operated its 150-ton magnetic separating plant on zinc sulphide ores.

The Chino Copper Co. continued to operate its 12,000-ton gravity concentration and oil flotation mill at 50 per cent of its capacity. The eleventh annual report of the company, for the year ending December 31, 1920 (dated April 15, 1921), says:

> The total net income for the year 1920 amounted to $1,319,541, as compared with $1,301,797 for the year 1919.
>
> Gross copper production for the year in concentrates and other shipping products was 46,088,609 pounds. After smelter deductions the net production was 44,051,849 pounds. In addition, gold was also produced to the value of $34,860.
>
> The operating cost of producing copper for the year, as shown in the report of the managing director, was 14.97 cents per pound, as compared with 15.53 cents per pound for the year 1919. If the credit for the gold and miscellaneous income of 0.57 cent per pound of net copper for 1920 were deducted, the net cost would be 14.40 cents per pound, as compared with 15.31 cents for the year 1919 calculated in the same way.

For the greater part of 1920 the properties of your company were operated on a basis of about 50 per cent, but toward the end of the year production was reduced to a rate less than 40 per cent of capacity.

The company now has 214 mining claims, covering a total area of 3,604 acres, of which number 183 are patented, comprising 3,151 acres, and 31 claims of 453 acres total unpatented. In addition to the foregoing, the company owns 120 acres of agriculture land adjacent to its group of mining claims, making a total of 3,724 acres of ground owned and controlled by the company in the central mining district, Grant County, N. Mex.

During the year, title and rights were acquired to 2,160 acres of grazing lands near the Hurley mill. Of these, title was confirmed to the 800 acres referred to in the 1919 report, and title rights were acquired to 1,360 acres, part of which was below the tailings dam, and another area which was necessary for the protection of a water supply. This increase in lands, in addition to lands already owned and controlled by the company in connection with its mill location at Hurley and its various water rights and tailings disposal system, makes a total area as of December 31, 1920, of 19,891 acres.

There was no development by drilling during the year. The long Pedro tunnel from the old No. 7 shaft was reopened and sampled. The copper content was too low to add anything from this source to the ore reserves. Valuable data from a geological standpoint was, however, obtained.

The result of the calculation which was completed as of January 1, 1921, using the best information available as to how the ore bodies will be mined and allowing for unavoidable dilution by low-grade material as experienced in practice, gives fully developed unmined ore reserves of 103,811,623 tons, averaging 1.53 per cent copper. In addition to the unmined ore, there are 1,789,159 tons, averaging 1.42 per cent copper, in the stock piles at Santa Rita, and 88,465 tons in a special reserve used for experimental purposes, averaging 1.37 per cent copper. The total ore, therefore, unmined or untreated, at the end of the year 1920 is 105,689,247 tons, of an average grade of 1.53 per cent copper.

Since the beginning of operations there have been shipped to the mill or direct to the smelter, 21,645,912 tons of ore, averaging 1.86 per cent copper. The total ore developed by churn drilling to date, including the ore actually removed to January 1, 1921, is therefore 127,335,159 tons, of an average grade of 1.58 per cent copper.

The total ore and waste removed by steam shovels during the year was 3,694,473 cubic yards. Of this amount, 2,522,135 cubic yards were stripping, the remainder being equivalent to 2,332,730 tons of ore. Of this ore, 1,895,506 tons were sent to the mill, 433,468 tons to the stock piles, and 3,756 tons were shipped to the smelter. At the end of the year there was a total of 1,789,159 tons of ore, averaging 1.42 per cent copper, in the ore stock piles.

From the beginning of steam-shovel operations on September 23, 1910, when the first shovel was erected, there has been removed a total of 41,562,412 cubic yards of material, of which 29,547,271 cubic yards were stripping, the remainder being equivalent to 23,519,831 tons of ore. Of this latter, 1,789,159 tons remained stored in the ore stock piles, 88,465 tons being in process of experimental treatment at the mine, while 21,614,663 tons have gone to the mill, and 27,544 tons have been shipped direct from the mine to the smelter.

Of the ore shipped to the mill during the year, 19.14 per cent came from the northwest ore body, 39.21 per cent came from the north ore body, 29.02 per cent came from the south ore body, and 12.63 per cent came from the southwest ore body. No ore was shipped from the ore stock piles to the mill.

The average cost of steam-shovel operations covering the removal of both ore and stripping for the year was 71.95 cents per cubic yard as compared to 64.91 cents per cubic yard for the year 1919, and 33.97 cents for 1915. The ratio of the cost of labor for the removal of ore and stripping in 1920, compared with 1915, is 1.939 to 1, while the cost of supplies is 2.25 to 1, and the ratio of all costs, including general administration, taxes, and depreciation is 2.11 to 1.

In the month of April there was an increase in wages, which continued in force until December 31, when a reduction was made reestablishing the schedule existing previous to July 1, 1919.

There was no new construction at the mill. Some improvements were, however, made in concentration departments and operations which have brought improved extractions.

MILL OPERATIONS.

There was treated in 1920 at the Hurley mill a total of 1,838,140 dry tons of ore, compared to 1,765,200 dry tons of ore treated during the year 1919. This tonnage is equivalent to an average of 5,022 tons per day, compared to an average of 4,836 tons

per day for the year 1919, or an increase of 186 tons per day. The average copper content of the ore treated during the year was 1.76 per cent, or approximately 0.06 per cent lower than that treated during the year 1919. The total production of concentrate amounted to 142,446 dry tons, which averaged 16.09 per cent copper. The total copper content of the concentrate was 45,827,636 pounds. This corresponds to a recovery of 24.93 pounds of copper per ton of ore, equivalent to an extraction of 70.67 per cent, which is 5 per cent higher than for the year 1919. This improvement was due both to the fact that the ore was of a better concentrating character than was milled during the year 1919 and to betterments made in milling practice.

The average cost of milling was $1.43 per ton, which is a decrease of 13 cents per ton when compared to the year 1919. This is mainly due to the larger tonnage milled in 1920, but also to some extent to greater efficiency of the operating forces.

The ratio of the cost of labor per ton of ore milled in 1920, compared with 1915, is 1.429 to 1, of supplies is 2.783 to 1, and the ratio of all costs calculated on the same basis, including labor, supplies, administration, depreciation, and taxes (except Federal tax), for the same years, is 2.115 to 1.

During the year there were shipped from the mine direct to the smelter a total of 3,756 tons of crude ore, containing 260,973 pounds gross of copper.

The production of copper contained in the concentrate and other shipping products for the year was 46,088,609 pounds, compared to 42,325,449 pounds for 1919. After allowing for smelter deductions the net output for the year was 44,051,849 pounds, compared to a total of 40,488,706 pounds produced in 1919.

The average operating cost per pound of copper produced for the year, excluding any reserves for Federal income or excess profits taxes, and without crediting precious metal values and regular miscellaneous income, was 14.97 cents, compared to 15.53 cents per pound, calculated in the same way, for the year 1919. The credit for precious metals amounted to 0.08 cent per pound of copper, and that for miscellaneous income to 0.49 cent per pound, making a total credit for precious metals and miscellaneous income of 0.57 cent per pound of copper for the year 1920, as compared to 0.216 cent for the year 1919.

The per pound cost of 14.97 cents for the year 1920 includes depreciation and charges for accrual of all taxes except Federal income and excess profits taxes, for which no reserves were set up in the year 1920. Deducting from the cost as above stated the miscellaneous revenue of 0.57 cent the net cost for the year under discussion was 14.40 cents per pound, as compared with 15.31 cents, determined in the same way, for the year 1919.

Chloride Flat district.—No shipments of silver ore were made from the Chloride Flat district, but a large quantity of manganese ores was shipped to steel mills.

Gold Hill district.—Oxidized gold ore from the Standard (or Cline) mine was treated in the 2-stamp amalgamation mill on the property. Several hundred tons of silver ore was shipped from the Good Luck mine by the Cooperative Mining Co.

Lone Mountain district (near Hurley).—From the Ben Hur property, opened by a shaft 30 feet deep, and from open cuts several hundred tons of silver ore, with siliceous gangue, was shipped.

Pinos Altos district.—Deep mines in the Pinos Altos district produced 1,444 tons of ore, carrying $3,168 in gold, 1,989 ounces of silver, 2,456 pounds of copper, 40,325 pounds of lead, and 43,247 pounds of zinc, with a total value of $12,517. Placer mines in this district produced 26.80 fine ounces of gold and 11 ounces of silver, with a total value of $566. The Calumet-New Mexico 100-ton gravity concentration and oil-flotation mill was operated on ores from the Langston and Manhattan mines. Several small shipments of lead and copper ore were made from other properties.

Steeplerock district.—The water in the Carlisle shaft was lowered to the 500-foot level, and of the gold ore mined, several cars were shipped direct to the El Paso smelter and 1,000 tons was milled in the 75-ton gravity-concentration and oil-flotation mill. Silver-gold ore was shipped from the Jim Crow-Imperial group and the Norman

King mine. The Duncan Mining & Milling Co. operated its 80-ton cyanidation mill for two months on gold-silver ore from the Golden Fleece mine.

Telegraph district.—A small lot of high-grade silver ore was shipped from the Bronx mine, 40 miles west of Silver City, on Gila River.

White Signal district.—During the year development work on the Merry Widow gold-silver-copper claims brought attention to the existence of the uranium-bearing mineral torbernite, and some exploratory work was done in an endeavor to determine the quantity of this mineral.

HIDALGO COUNTY.[1]

Apache No. 2 (Hachita) district.—Several cars of silver-lead oxidized and copper oxidized ores were shipped from the Apache mine.

Eureka (Hachita district.)—Several hundred tons of silver ore was shipped from the American mine, and both copper and silver ores were shipped from the King 400 mine.

Fremont district.—A small lot of silver ore was shipped from the Canovello (or Doyle) mine.

Red Hill district.—A car of lead-silver ore was shipped from the Red Hill group.

Lordsburg district (including Pyramid and Virginia or Shakespeare districts).—The production of the Lordsburg district from seven mines was 55,307 tons, carrying $153,461 in gold, 182,000 ounces of silver, 2,695,674 pounds of copper, and 98,312 pounds of lead, with a total value of $855,530, as compared with $1,103,753 in 1919. The Eighty-Five mine continued to be the principal producing property, and shipped direct to smelters a large quantity of siliceous ore carrying gold and silver bearing copper sulphides. Up to March, 1920, lessees on the Last Chance mine continued the extraction of silver ore, which was highly concentrated in the gravity-concentration and oil-flotation mill on the property. Several cars of silver ore were shipped from the Atwood mine, and several hundred tons of copper ore was shipped from the Miser's Chest mine.

Steins district.—During the period January to May lessees on the King and Queen mine shipped several cars of lead-silver ore.

LINCOLN COUNTY.

Nogal (Bonito, Parsons) district.—Much development work was done at the Helen Rae group, with promise of production in 1921. Development work also continued at the Bender group. The Vera Cruz Leasing Co.'s mill was idle.

Whiteoaks district.—Several hundred tons of gold ore was treated at the Homestake 20-stamp amalgamation mill.

Red Cloud (Gallinas Mountains) district.—Development work begun in 1919 at the Red Cloud mine resulted in the shipment in 1920 of several hundred tons of lead-silver carbonate ore.

[1] For review of districts prior to 1920, see Grant County.

LUNA COUNTY.

Cooks Peak district.—Lead and zinc ores shipped from the Cooks Peak district in 1920 amounted to only 136 tons.

Victorio (Gage) district.—Lessees on the Rambler and Helen and Jessie mines shipped several hundred tons of lead-silver ore from the claims of the Victor Smelting & Mining Co. Operations on the Chance and Rover mines continued with production of oxidized lead-silver ore during the early part of the year only, until the Parole mine was opened as a shipper by the sinking of a 100-foot inclined shaft.

OTERO COUNTY.

No ores containing gold, silver, copper, and lead were shipped from any of the districts in Otero County, but iron ores were shipped to the steel plant at Pueblo, Colo., from Orogrande. At the Little Annie mine, at Orogrande, a small milling plant, consisting of a crusher, a Huntington mill, and amalgamating plates, was operated, but the bullion produced was not refined or sold.

SANDOVAL COUNTY.

A car of lead ore was shipped from the Montezuma group, at Placitas, and two cars of copper ore were shipped from the San Miguel Mining Co.'s property, at Senorito.

SAN MIGUEL COUNTY.

Development work, begun in 1918 for the purposes of examination of ore bodies, was continued in 1920 at the Pecos mines, at the junction of Willow Creek and Pecos River.

SANTA FE COUNTY.

Cerrillos district.—None of the mines in the Cerrillos district were operated in 1920. The Grubnau, Bryant & Grubnau zinc oxide plant, at Waldo, continued operations on New Mexican and Mexican zinc carbonate ores.

New Placers (Golden) district.—At the Amazon-Anaconda-Lincoln group of the Collier Mines Co. the vertical shaft was sunk 230 feet, making a total of 420 feet, which is about 46 feet below the oxidized zone. The sulphide ore is a silver-lead-zinc complex, for the treatment of which a gravity-concentration and oil-flotation plant is planned. Several cars of the oxidized ore carrying zinc carbonate, calcite, and manganese oxide, with low content of silica, were sold to the Waldo zinc oxide plant. Small quantities of gold ore from the Abyeta mine were treated by amalgamation. A car of copper carbonate ore was shipped from the Copper Basin No. 1 and Gold King mines. Some gold ore was shipped to the El Paso smelter, and small pieces of specimen gold were sold from the Las Vegas mine. Development was continued at the St. Paul-St. Luke group.

SIERRA COUNTY.

The mine production of Sierra County in 1920 was 6,957 tons of ore, from which was derived $15,896 in gold, 117,089 ounces of silver, 43,826 pounds of copper, and 84,264 pounds of lead, valued in all at $158,328, an increase of 2,916 tons of ore, $11,948 in gold, 49,431 ounces of silver, 12,165 pounds of copper, 34,585 pounds of lead, and $70,081 in total value.

Chloride (Apache, Cuchillo Negro) district.—From the Silver Monument mine, opened by an adit 1,500 feet long, a 100-foot raise,and 175 feet of drifts, sulphide ore was mined and concentrated into a copper concentrate carrying a high content of silver. During development work on the Egypt group a few tons of good grade lead-silver-gold ore was mined and shipped to El Paso. A few tons of silver ore was shipped from the Great Republic dump, and a small lot of high-grade silver ore from a 40-foot hole on the Polish No. 1 claim. A car of silver ore was shipped from the Midnight mines.

Hillsboro (Las Animas) district.—The Hillsboro Development Co., lessees, shipped from the Bonanza mine three cars of high-grade gold-silver-copper ore to El Paso, and also considerable gold bullion, the result of development work in 1919–20. Two cars of gold ore were shipped from the Snake-Opportunity group.

Kingston district.—A car of silver ore was shipped from the Illinois-Saratoga group, and a car of silver ore from the Virginian mine. From the Lady Franklin group, opened by an adit 2,000 feet long and an 80-foot winze, several hundred tons of good grade silver ore was shipped. In the course of development work on the Percha group several cars of lead-copper-silver ore were mined and shipped.

Lake Valley district.—Continuation of mining begun in 1919 at the old Lake Valley mine resulted in the shipment to El Paso of several thousand tons of oxidized ore carrying silver sufficient to market the ore and to steel plants of over 1,000 tons of good grade manganese-iron ore. Development work was continued at the Roper group, 7 miles southwest of Lake Valley.

Pittsburg district (Caballos Mountains).—Assessment work was done on the Marion group, on which the developments consist of a 1,000-foot adit on the Marion, two 50-foot adits on the Rebecca, and a 1,000-foot adit on the Oohoo claim. Some development work was done on the claims of the Grass Roots Gold & Copper Co. In this district there are several fluorspar prospects near Derry.

SOCORRO COUNTY.

In 1920 the mines of Socorro County produced 59,130 tons of ore, a decrease of 11,339 tons, $125,631 in gold, a decrease of $22,515, 347,856 fine ounces of silver, a decrease of 65,061 ounces, 312,245 pounds of copper, a decrease of 296,658 pounds, 875,062 pounds of lead, an increase of 55,496 pounds, and 3,764,235 pounds of zinc, an increase of 768,495 pounds; the total value was $937,155, a decrease of $48,840.

Magdalena (Kelly) district.—Five mines in the Magdalena district produced 17,235 tons of ore, which yielded 18,367 ounces of silver, 311,663 pounds of copper, 873,012 pounds of lead, and 3,764,235 pounds of zinc and had a total value of $452,110, as compared with 13,938 tons of ore and a total value of $407,352 in 1919.

From the Kelly mine two cars of lead-silver oxidized ore and several cars of zinc carbonate ore were shipped to smelters. A car of lead-silver ore was shipped from the Germany mine, and several cars of silver ore from the Hardscrabble mine. A few cars of lead-silver oxidized ore and zinc carbonate ore were shipped from the Juanita mine. The Graphic mine was operated all the year and shipped copper sulphide, oxidized lead, zinc-lead sulphide, and oxidized zinc ores. The Graphic 100-ton flotation mill was operated for only three months. The product, zinc concentrate (with the addition of some concentrate accumulated in 1918–19), was shipped.

Mogollon (Cooney) district.—The Mogollon district produced 41,895 tons of ore, which yielded $125,631 in gold, 329,489 ounces of silver, 582 pounds of copper, and 2,050 pounds of lead, and had a total value of $485,045, as compared with 56,531 tons, having a total value of $578,643 in 1919. The silver from this district represented 43 per cent of the State output, and the gold 26 per cent.

The Mogollon Mines Co.'s 40-stamp cyanidation-concentration mill was operated steadily on ore from the Dutch Boy, Black Bird, Confidence, Top, Last Chance, Eberle, and Pacific claims. The Fanney mill remained idle.

TAOS COUNTY.

A small shipment of copper ore was made from the Champion mine, near Dixon.

TORRANCE COUNTY.

The surface outcrops of copper minerals in limestone and shaly limestone of the "Red Beds" of the Carocito district, north of Scholle, from which several thousand tons of copper ore was shipped in 1916–1919, were not worked in 1920.

GOLD, SILVER, COPPER, AND LEAD IN TEXAS.

(MINES REPORT.)

By Charles W. Henderson.

Mine production of gold, silver, copper, and lead in Texas, 1919–20.

Year.	Gold.	Silver.		Copper.		Lead.		Total value.
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
		Fine ounces.		*Pounds.*		*Pounds.*		
1919	$25	538,642	$603,279	979	$182	13,131	$696	$604,182
1920	.....	511,401	557,427	14,435	2,656	.....	.....	560,083
Increase or decrease, 1920.	−25	−27,241	−45,852	+13,456	+2,474	−13,131	−696	−44,099

Owing to general conditions in the mining industry no gold or lead was produced in Texas in 1920.

Culberson County.—A total of 227 tons of copper ore carrying 2,800 ounces of silver and 14,435 pounds of copper was shipped from three mines in the Allamoore district.

Presidio County.—The quantity of silver bullion produced at the 125-ton cyanidation mill of the Presidio mine, Shafter district, was somewhat less in 1920 than in 1919. Since the beginning of mining in Texas, in 1885, this mine has produced the greater part of the State's silver output—14,755,092 fine ounces, having a commercial value of $10,321,854.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO.

(MINES REPORT.)

By Charles W. Henderson.

PRODUCTION.

The total gross calculated value of the gold, silver, copper, lead, and zinc produced in Colorado in 1920 showed an increase of 1 per cent over the value in 1919.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1919–1920.[a]

Year.	Number of producing mines.	Ore.	Gold.		Silver.[b]	Copper.	Lead.	Zinc.	Total value.
			Placer.	Deep.					
		Short tons.			*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
1919	464	1,919,768	$550,562	$9,336,065	5,758,010	3,560,207	37,070,241	37,220,493	$21,679,614
1920	416	1,571,293	514,588	7,061,731	5,409,335	4,043,734	46,629,788	48,790,742	21,898,974
Increase or decrease, 1920.	−48	−348,475	−35,974	−2,274,334	−348,675	+483,527	+9,559,547	+11,570,249	+219,360

[a] A revised table showing the production of gold, silver, copper, lead, and zinc from the beginning of mining in Colorado to 1920 will be included in a professional paper, "The history and development of mining in Colorado, 1859–1920," now in preparation.
[b] Includes placer production.

ORE.

In 1920 amalgamating and cyaniding mills, with or without concentration equipment (including all the custom mills of the State), treated 626,900 short tons of ore and made an average of 0.356 ounce of gold and 0.221 ounce of silver to the ton. From this ore and from 677,113 tons sent to concentration and separation mills—a total sent to mills of both classes of 1,304,013 tons (83 per cent of the total quantity treated, as against 85 per cent in 1919)—119,233 tons of concentrates were produced, the ratio being 11 to 1.

GOLD.

The total production of gold in Colorado in 1920 was 366,504.43 fine ounces, valued at $7,576,319, a decrease of 111,761.15 fine ounces

and of $2,310,308, following a decrease of $2,865,091 in 1919 and of $2,977,506 in 1918.

The Cripple Creek district had the smallest output since 1894, but it furnished more than 57 per cent of the State yield in 1920. The San Juan region of Dolores, La Plata, Ouray, San Juan, and San Miguel counties yielded $1,654,139, a decrease for the region of $684,732. There were increases of $142,409 in Lake County and $134,206 in San Juan County, and decreases of $26,865 in Chaffee, $42,587 in Clear Creek, $118,214 in Gilpin, $58,561 in Ouray, $765,264 in San Miguel, and $1,503,818 in Teller.

The output of placer gold in 1920 was $514,588, a decrease of $35,974. Summit County, with 4 dredges, 1 sluice mine, and 1 hydraulic mine, produced nearly 73 per cent of the placer yield, and one dredge and one sluice mine in Lake County produced 27 per cent. The remainder came from hydraulicking and sluicing in Moffar Montrose, and Park counties.

SILVER.

The yield of silver in Colorado in 1920 was valued at $5,896,175, a decrease of $552,796. The greatest increases in production were in Eagle, Saguache, and San Juan counties.

COPPER.

The output of copper in 1920 was valued at $744,047, an increase of $81,849. Although copper is widespread in the ores of Colorado, there are strictly no producing copper mines in the State, and the output for each year is mainly a valuable by-product of other ores.

San Juan County produced nearly 34 per cent of the copper output, San Miguel more than 23 per cent, Lake nearly 20 per cent, and Eagle 13 per cent.

LEAD.

The production of lead (in terms of lead in lead bullion and in leaded-zinc oxide) in Colorado in 1920 was valued at $3,730,383, an increase of $1,765,661.

There were decreases in Chaffee, Lake, Mineral, Ouray, Pitkin, Eagle, and Gilpin counties, and heavy increases in Clear Creek, Dolores, Gunnison, Park, and San Juan counties.

San Juan County was first in rank, followed by Lake, San Miguel, Pitkin, Clear Creek, Ouray, Park, and Gunnison. There was a large decrease in quantity of lead ores produced and in their lead content, but an increase of lead-zinc ores. There was also a decrease in quantity of dry ores, but an increase in lead content.

ZINC.

In 1920 the marketed zinc ores from Colorado contained recoverable zinc valued at $3,952,050, an increase of $1,234,954.

Lake County produced 38 per cent of the zinc output of the State, as compared with 62 per cent in 1919 and 52 per cent in 1918. Leadville shipments of zinc carbonate ore amounted to 16,726 tons, carrying 21.79 per cent of zinc; lead-zinc and zinc sulphide ores sold or treated in Leadville amounted to 30,899 tons, carrying 27.13 per cent of zinc.

OUTPUT OF ORE AND METAL CONTENT.

Ore and metals produced in Colorado in 1920.

Source of production.	Ore.		Gold.		Silver.	
	Short tons.	*Per cent.*	*Fine ounces*	*Per cent.*	*Fine ounces.*	*Per cent.*
Dry gold ore	505,885	32.20	246,061.02	67.14	187,181	3.46
Dry silver ore	351,899	22.40	6,893.30	1.88	2,497,880	46.18
Dry gold and silver ore	366,297	23.31	62,173.38	16.96	952,257	17.60
Total dry ores	1,224,081	77.91	315,127.70	85.98	3,637,318	67.24
Copper ore	3,835	.24	2,150.54	.59	100,643	1.86
Copper-lead ore	453	.03	173.47	.05	7,566	.14
Lead ore	61,254	3.90	11,459.90	3.12	841,783	15.57
Lead-zinc ore	185,438	11.80	12,144.71	3.32	726,472	13.43
Zinc ore	96,232	6.12	554.91	.15	88,837	1.64
Total all other ores	347,212	22.09	26,483.53	7.23	1,765,301	32.64
Total, deep mines	1,571,293	100.00	341,611.23	93.21	5,402,619	99.88
Total, placers	.....	.....	24,893.20	6.79	6,716	.12

Source of production.	Copper.		Lead.		Zinc.	
	Pounds.	*Per cent.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
Dry gold ore	358,034	8.85	715,357	1.54	77,635	.16
Dry silver ore	831,728	20.57	7,002,932	15.02	.....	.....
Dry gold and silver	1,055,118	26.09	8,981,473	19.26	.....	.....
Total dry ores	2,244,880	55.51	16,699,762	35.82	77,635	.16
Copper ore	383,427	9.48	41,937	.09	.....	.....
Copper-lead ore	30,865	.76	184,011	.39	.....	.....
Lead ore	235,177	5.82	11,892,212	25.50	.....	.....
Lead-zinc ore	1,109,381	27.44	16,105,887	34.54	15,256,850	31.27
Zinc ore	40,004	0.99	1,705,979	3.66	33,456,257	68.57
Total all other ores	1,798,854	44.49	29,930,026	64.18	48,713,107	99.84
Grand total	4,043,734	100.00	46,629,788	100.00	48,790,742	100.00

Placer output in Colorado in 1920, in fine ounces.

County.	Sluice and hydraulic.		Dredges.		Total.	
	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.
Lake	2.90	.....	6,714.64	1,900	6,717.54	1,900
Montrose	9.58	2	.....	.....	9.58	2
Moffat	5.71	.....	.....	.....	5.71	.....
Park	25.45	3	.....	.....	25.45	3
Summit	39.17	17	18,095.75	4,794	18,134.92	4,811
Total, 1920	82.81	22	24,810.39	6,694	24,893.20	6,716
Total, 1919	409.18	87	26,224.26	7,056	26,633.44	7,143

Content of dry gold ores sold or treated in Colorado in 1920.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Boulder	722	1,299.97	1,118	591	890	.....
Clear Creek	2,537	721.65	3,082	5,642	49,110	.....
Eagle	121	89.80	318	.....	.....	.....
Gilpin	7,187	3,052.10	7,204	20,984	136,596	.....
Gunnison	639	1,162.11	8,189	.....	23,638	.....
Hinsdale	40	149.61	507	.....	2,005	.....
Lake	21,247	25,922.25	119,292	291,277	457,554	.....
La Plata	183	394.10	1,625	.....	49	.....
Ouray	154	347.10	536	.....	.....	.....
Park	23	42.00	96	.....	.....	.....
San Juan	19,214	1,425.91	8,032	38,873	26,305	.....
San Miguel	800	1,899.56	2,103	216	5,506	.....
Summit	4,400	381.46	1,290	.....	13,092	77,635
Teller	448,618	209,173.40	33,789	451	612	.....
Total, 1920	505,885	246,061.02	187,181	358,034	715,357	77,635
Total, 1919	1,111,640	396,354.31	724,260	905,068	4,113,337	.....

Content of dry gold and silver ores sold or treated in Colorado in 1920.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Boulder	4,278	482.01	12,360	.....	19,793
Clear Creek	174	23.36	545	615	4,489
Eagle	41	49.20	754	697	.....
Gilpin	418	304.43	7,200	17,100	31,295
Hinsdale	69	120.40	1,485	.....	927
La Plata	124	119.40	1,164	.....	93
Ouray	925	100.20	1,614	820	34,168
Routt	3	2.13	100	.....	.....
San Juan	17,885	1,175.39	32,044	146,243	2,375,807
San Miguel	342,380	59,796.86	894,991	889,643	6,514,901
Total, 1920	366,297	62,173.38	952,257	1,055,118	8,981,473
Total, 1919	111,961	21,984.11	527,072	266,154	3,181,276

Content of dry silver ores sold or treated in Colorado in 1920.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Boulder	14,371	191.98	127,289	5,016	209,750
Chaffee	176	9.20	1,603	1,302	7,745
Clear Creek	38,926	747.38	104,981	19,498	372,690
Custer	459	7.30	11,495	993	19,485
Dolores	593	40.39	5,750	1,951	2,497
Eagle	12,100	862.10	249,468	492,479	.....
Gilpin	1,813	33.89	3,718	.....	35,744
Gunnison	10	2.28	655	.....	746
Hinsdale	365	25.24	18,527	2,004	12,055
Lake	79,277	1,455.72	675,472	207,832	1,904,584
La Plata	410	19.59	7,789	.....	795
Mineral	12,597	276.22	272,322	1,120	531,537
Ouray	38,234	1,155.45	372,221	30,056	949,215
Park	1,067	7.80	7,998	2,021	43,231
Pitkin	108,292	.....	418,944	.....	2,414,554
Saguache	8,871	150.66	64,973	37,226	126,864
San Juan	29	13.81	2,319	122	280
San Miguel	22,360	989.20	67,076	29,836	326,615
Summit	11,949	905.09	85,280	272	44,545
Total, 1920	351,899	6,893.30	2,497,880	831,728	7,002,932
Total, 1919	443,475	10,958.46	2,979,721	510,108	7,593,286

Content of copper ores sold or treated in Colorado in 1920.[a]

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Chaffee	148	0.92	189	9,511	850
Clear Creek	198	189.34	3,993	24,646	8,545
Dolores	22	.....	177	2,022	1,700
Eagle	197	12.40	2,117	23,933	.....
Gilpin	396	573.96	2,078	34,010	588
Lake	2,052	1,221.20	50,419	160,355	13,156
Ouray	114	3.90	5,291	40,172	40
Park	65	0.40	2,051	6,246	1,559
Saguache	338	88.42	29,041	46,595	7,496
San Juan	275	50.70	4,693	33,970	7,986
San Miguel	30	9.30	594	1,967	17
Total, 1920	3,835	2,150.54	100,643	383,427	41,937
Total, 1919	9,417	4,992.49	104,381	774,435	58,466

[a] All smelting ore.

Content of lead-copper ores sold or treated in Colorado in 1920.[a]

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Boulder	2	1.02	27	159	269
Chaffee	41	0.40	633	3,016	23,189
Clear Creek	97	29.56	1,964	4,840	60,718
Custer	30	.....	439	2,013	3,136
Gilpin	127	126.89	1,528	10,732	51,977
Hinsdale	2	0.40	53	621	224
Saguache	73	4.30	641	4,565	15,703
San Juan	71	10.40	968	4,241	27,773
San Miguel	10	0.50	1,313	678	1,022
Total, 1920	453	173.47	7,566	30,865	184,011
Total, 1919	1,690	339.40	34,749	193,197	342,847

[a] All smelting ore.

Content of lead ores sold or treated in Colorado in 1920.

County.	Ore.	Gold.	Silver.	Copper.	Lead.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Boulder	103	77.47	8,040	919	30,386
Chaffee	2,782	1,503.72	36,786	14,366	350,972
Clear Creek	2,335	570.75	69,616	6,737	820,207
Custer	1,011	31.30	22,322	25,027	148,941
Dolores	1,580	71.89	25,960	2,366	680,120
Gilpin	879	333.54	20,272	3,777	178,812
Grand	3	.....	856	.....	525
Gunnison	4,516	.....	11,711	.....	534,543
Hinsdale	92	1.90	950	.....	65,414
Lake	22,787	1,549.60	183,979	100,276	4,716,313
Ouray	768	27.31	85,915	15,833	351,152
Park	4,193	6,849.62	40,875	10,407	1,040,835
Pitkin	16,411	.....	199,918	.....	1,809,699
San Juan	1,627	237.28	98,822	47,893	627,911
San Miguel	589	72.30	26,650	7,489	262,617
Summit	1,578	133.22	9,111	87	273,765
Total, 1920	61,254	11,459.90	841,783	235,177	11,892,212
Total, 1919	74,918	10,205.10	1,068,360	427,618	15,085,420

Content of lead-zinc ores sold or treated in Colorado in 1920.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Chaffee	95				13,494	43,011
Clear Creek	7,227	66.08	35,719		1,141,341	372,420
Dolores	557	1.40	280	465	88,271	229,865
Gunnison	1,258				399,374	502,913
Lake	4,648	20.20	12,729		221,200	1,477,839
Pitkin	1,083		6,582		246,047	617,790
San Juan	162,570	9,991.32	599,222	1,090,049	13,534,963	11,837,395
San Miguel	8,000	2,065.71	71,940	18,867	461,197	175,617
Total, 1920	185,438	12,144.71	726,472	1,109,381	16,105,887	15,256,850
Total, 1919	116,120	6,717.87	283,741	483,627	5,837,856	21,079,069

Content of zinc ores sold or treated in Colorado in 1920.

County.	Ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Chaffee	658					240,224
Eagle	20,176	219.87	27,010		282,538	6,653,235
Gunnison	2,020					1,027,778
Lake	42,977	283.15	55,897	40,004	1,277,381	17,276,692
Summit	30,401	51.89	5,930		146,060	8,258,328
Total, 1920	96,232	554.91	88,837	40,004	1,705,979	33,456,257
Total, 1919	50,547	80.40	28,583		857,754	16,141,424

Gold and silver produced at mills in Colorado, 1920.

	Ore to gold and silver mills.	Gold in bullion.	Silver in bullion.	Ore to concentrating mills.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Short tons.*
Boulder	404	633.24	10	17,565
Clear Creek	1,474	198.27	54	46,147
Eagle				20,118
Gilpin	6,221	674.59	156	2,567
Gunnison				4,516
Lake	1,479	2,990.85	628	5,532
Ouray				38,533
Park				996
Pitkin			798	91,333
Saguache				8,430
San Juan	19,214	197.31	23	180,441
San Miguel	145,189	20,884.28	108,813	228,351
Summit	4,400	236.38	113	32,584
Teller	448,519	197,547.88	27,712	
Total, 1920	626,900	223,362.80	138,307	677,113
Total, 1919	1,195,986	346,035.56	242,269	439,373
Average content per ton 1920		0.3563	0.2206	

Mine production of metals from Colorado concentrates in 1920.

By counties.

County.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Boulder	439	526.68	45,883		177,019	
Clear Creek	3,387	1,005.37	116,664	23,942	1,511,676	372,420
Eagle	15,544	254.07	27,159		282,538	6,546,554
Gilpin	1,002	1,281.55	9,106	11,955	220,694	
Gunnison	603		11,711		534,543	
Lake	4,196	517.90	11,101		138,243	1,154,376
Ouray	3,334	1,228.20	338,524	28,208	919,806	
Park	78	1.30	5,757	1,658	42,422	
Pitkin	12,602		208,317		1,655,584	
Saguache	545	126.66	47,697	37,082	113,843	
San Juan	34,734	12,378.52	638,935	1,275,165	15,937,075	11,837,395
San Miguel	27,649	43,867.05	927,297	938,562	7,308,219	175,617
Summit	11,625	232.37	13,925		201,465	8,335,963
Teller	3,495	10,892.60	4,260			
Total, 1920	119,233	72,306.27	2,406,336	2,316,572	29,043,127	28,422,325
Total, 1919	100,775	60,258.60	2,123,721	1,626,272	19,014,621	20,704,184

By kinds of concentrates.

Class.	Concentrates.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry gold	6,228	13,406.53	17,199	43,377	89,799	.....
Dry silver	13,518	1,428.10	194,202	29,836	1,109,288	.....
Dry gold and silver	1,018	3,352.33	76,807	.....	7,899	.....
Copper	20	28.50	210	1,607	236	.....
Lead	45,330	24,674.82	1,571,067	958,249	20,871,928	.....
Lead-copper	14,552	25,958.29	332,696	817,029	3,952,032	.....
Total to copper and lead plants	80,666	68,848.57	2,192,181	1,850,098	26,031,182	.....
Zinc	38,526	3,453.47	212,474	466,474	3,005,877	28,395,505
Lead-zinc	41	4.23	1,681	.....	6,068	26,820
Total to zinc and lead-zinc plants	38,567	[a] 3,457.70	[a] 214,155	[a] 466,474	[b] 3,011,945	[c] 28,422,325
	119,233	72,306.27	2,406,336	2,316,572	29,043,127	28,422,325

[a] Recovered in zinc residues.
[b] Lead recovered in zinc residues and leaded zinc oxide.
[c] Zinc recovered as metal and zinc in zinc oxide.

Average content of concentrates.

	Gold.	Silver.	Copper.	Lead.	Zinc.
	Fine ounces per ton.	*Fine ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*
Dry gold	2.15	2.76	0.35	0.70	.....
Dry silver	.11	14.37	.11	4.10	.....
Dry gold and silver	3.29	75.45	.....	.38	.....
Copper	1.43	10.50	4.02	.59	.....
Lead	.54	34.66	1.06	23.02	.....
Lead-copper	1.78	22.86	2.81	13.58	.....
Total average	.85	27.18	1.15	16.14	.....
Zinc	.09	5.52	.61	3.90	[d] 46.06
Lead-zinc	.10	41.00	.....	7.40	[d] 40.89
Total average	.09	5.55	.60	3.90	[d] 46.06

[d] Assay of content; no deduction for loss in smelting.

Mine production of metals from Colorado crude ore shipped to smelters in 1920.

By counties.

County.	Crude ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Boulder	1,507	898.53	102,941	6,685	84,069	.....
Chaffee	3,900	1,514.24	39,211	28,195	396,250	283,235
Clear Creek	3,873	1,144.48	103,182	38,036	945,424	.....
Custer	1,500	38.60	34,256	28,033	171,562	.....
Dolores	2,752	113.68	32,167	6,804	772,588	229,865
Eagle	12,517	979.30	252,508	517,109	.....	106,681
Gilpin	2,032	2,468.67	32,738	74,648	214,318	.....
Grand	3	.....	856	.....	525	.....
Gunnison	3,927	1,164.39	8,844	.....	423,758	1,530,691
Hinsdale	568	297.55	21,522	2,625	80,625	.....
Lake	165,977	26,943.37	1,086,059	799,744	8,451,945	17,600,155
La Plata	717	533.09	10,578	.....	937	.....
Mineral	12,597	276.22	272,322	1,120	531,537	.....
Ouray	1,662	405.76	127,053	58,673	414,769	.....
Park	4,352	6,898.52	45,263	17,016	1,043.203	.....
Pitkin	34,453	.....	416,329	.....	2,814,716	617,790
Routt	3	2.13	100	.....	.....	.....
Saguache	852	116.72	46,958	51,304	36,220	.....
San Juan	2,016	328.98	107,142	86,226	663,950	.....
San Miguel	629	82.10	28,557	10,134	263,656	.....
Summit	11,344	1,002.91	87,573	359	275,997	.....
Teller	99	732.92	1,817	451	612	.....
Total, 1920	267,280	45,942.16	2,857,976	1,727,162	17,586,661	20,368,417
Total, 1919	284,409	45,337.98	3,384,877	1,933,935	18,055,620	16,516,309

By kinds of ore.

Class.	Crude ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry gold	20,439	27,393.86	135,144	303,784	494,231	.....
Dry silver	136,850	3,881.28	1,708,207	716,507	3,415,032	.....
Dry gold and silver	796	706.76	14,515	18,009	33,427	.....
Copper	3,835	2,150.54	100,643	383,427	41,937	.....
Copper-lead	453	173.47	7,566	30,865	184,011	.....
Lead	55,292	11,351.70	826,513	234,101	11,293,456	.....
Total to lead and copper plants	217,665	45,657.61	2,792,588	1,686,693	15,462,094	.....
Zinc	45,813	283.15	55,897	40,004	1,277,381	18,651,375
Lead-zinc	3,802	1.40	9,491	465	847,186	1,717,042
Total to zinc smelters and zinc oxide plants	49,615	[a] 284.55	[a] 65,388	[a] 40,469	[b] 2,124,567	[c] 20,368,417
	267,280	45,942.16	2,857,976	1,727,162	17,586,661	20,368,417

[a] Recovered in zinc residues.
[b] Lead recovered in zinc residues and leaded zinc oxide.
[c] Zinc recovered as metal and zinc in zinc oxide.

Average content of crude ores smelted.

Class of ore.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Fine. ounces.	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry gold	1.34	6.61	0.74	1.21	.....
Dry silver	.03	12.49	.26	1.25	.....
Dry gold and silver	.89	18.23	1.13	2.10	.....
Copper	.56	26.24	5.00	.55	.....
Copper-lead	.38	16.70	3.41	20.31	.....
Lead	.21	1.49	.21	10.21	.....
Total average	.21	12.83	.39	3.55	.....
Zinc	.01	1.22	.04	1.39	[d] 25.45
Lead-zinc	.....	2.50	.01	11.14	[d] 28.23
Total average	.01	1.32	.04	2.14	[d] 25.66

[d] Assay of content; no deduction for loss in smelting.

Ore, concentrates, and tailings sent to amalgamation and cyanidation mills and gold and silver contained in bullion and precipitates in Colorado in 1920.

Process.	Quantity.	Gold in bullion.	Silver in bullion.	Quicksilver used.	Sodium cyanide used.
	Short tons.	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*
Amalgamation	379,348	83,678.51	18,861	2,464	.....
Cyanidation	[a] 473,162	137,986.93	118,815	.....	338,763
Total	.....	221,665.44	137,676	.....	.....

[a] Includes crude ore, concentrates, and also slimes and sands from amalgamating mills.

MINING INDUSTRY.

The mine production of metals in Colorado in 1920 in terms of gross calculated value was held equal to that in 1919 by the influence of the enlarged and continuous operations of the Sunnyside mine's new 500-ton mill at Eureka, San Juan County. With the declining

market for lead and zinc this mine and mill closed in December, 1920. The Salida lead smelter closed in February, leaving three operating lead smelters, at Leadville, Durango, and Pueblo. The zinc oxide plant at Leadville continued operations throughout the year and completed construction of a new block in August, but the new block was not placed in operation. The Empire Zinc Co. completed a very modern zinc oxide plant at Canon City, but the declining zinc market did not warrant its operation. The Empire Zinc Co.'s magnetic separation plant, also at Canon City, successfully operated on lead-zinc-iron sulphide ores since 1902, was closed in November. The River Smelting & Refining Co.'s plant at Florence for the treatment of copper-lead-zinc ores by the matting and fuming process was operated until December. The United States Zinc Co.'s zinc retort and zinc oxide plant at Pueblo was operated on part capacity.

The Cripple Creek gold district, in Teller County, labored under the difficulty of high costs, but produced $4,323,998 in gold, as compared with $5,827,816 in 1919.

Mining at Leadville, where a variety of ores are produced, was at a low ebb at the end of 1919, but ore shipments increased during 1920, and the A. V. smelter "blew in" a fourth furnace. The Ibex mine opened some very high grade ore during the year. Some manganese ore found a market again at steel mills. The Derry Ranch dredge, below Leadville, resumed operations in May and was successfully operated until December.

Breckenridge, with its lead carbonate and zinc-iron and lead sulphide ores and its four active gold dredges, increased its output of zinc 100 per cent, and the dredges and other placer operations produced $374,882, as compared with $464,540 in 1919.

Much development work was done on the zinc deposits at Red Cliff, and zinc sulphide milling ore was shipped from this camp to Canon City and much pyritic silver ore to the lead smelter at Leadville.

The mines at Aspen, Pitkin County, maintained about the usual production of silver and lead. From the deposit of lead-zinc ore discovered at Lenado, near Aspen, considerable ore was shipped in 1920.

San Juan County showed a very large increase in metal output. The Sunnyside Co., at Eureka, after a long building program and many setbacks by fire and snowslides, began milling early in 1920 a large quantity of lead-zinc-silver ores. The Iowa-Tiger mine, at Silverton, continued production under lease until December.

San Miguel County maintained its usual activity, although the total output of metals was slightly less than in 1919. Early in the year the Tom Boy Co., at Telluride, set in operation its new oil-flotation mill, but it took several months to get the mill running smoothly. The Smuggler Union Co. continued mining and milling operations and development work, including the addition of a flotation plant, which, unfortunately, was destroyed by fire but which was replaced by a new plant of concrete construction. The Liberty Bell Co., which operated its property successfully from 1896 until the winter of 1919–20, decided in the spring to resume operations.

The Belmont-Wagner mill began operations at its Alta mines and mills, where much building and development work had been done during 1918 and 1919.

Mining continued at Red Mountain, Ouray, and Sneffels, although not as actively as in the last few years, and the Camp Bird Co. continued development from its adit, which in 1919 had cut the vein 500 feet below the level of previous successful operations. Creede, Mineral County, did not produce as much as in 1919. In Hinsdale County some new development work was done and some shipments were made.

Clear Creek County's production was less than usual. In May the Colorado Central mill, at Georgetown, in 1919 a large producer of silver concentrates from an old dump, was closed. The Wasatch mill, at Silver Plume, resumed operations during the year, yielding a lead and a zinc concentrate. The Gem mines were reopened under new management and with the acquisition of adjacent property. Gilpin County's output from operations through the Argo tunnel had practically ceased with the closing in 1919 of the Argo mill and Tremont mines, but development work and some production continued at several mines at Russell Gulch, Black Hawk, and Apex.

In Custer County operations were continued, but with decreased production, at several silver mines reopened in 1918 and 1919. Park County mines showed increased production of gold and lead. Drilling of placer areas near Fairplay has resulted in the digging of a pit for the installation of a dredge.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1920.

County.	Producing mines.	Ore sold or treated.	Gold.[a]		Silver.[a]	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Boulder	37	19,476	2,052.45	$42,428	148,834	$162,229
Chaffee	6	3,900	1,514.24	31,302	39,211	42,740
Clear Creek	65	51,494	2,348.12	48,540	219,900	239,691
Custer	8	1,500	38.60	798	34,256	37,339
Dolores	7	2,752	113.68	2,350	32,167	35,062
Eagle	9	32,635	1,233.37	25,496	279,667	304,837
Gilpin	29	10,820	4,424.81	91,469	42,000	45,780
Grand	1	3			856	933
Gunnison	7	8,443	1,164.39	24,070	20,555	22,405
Hinsdale	9	568	297.55	6,151	21,522	23,459
Lake	60	172,988	37,169.66	768,365	1,099,688	1,198,660
La Plata	9	717	533.09	11,020	10,578	11,530
Mineral	12	12,597	276.22	5,710	272,322	296,831
Moffat	2		5.71	118		
Montrose	1		9.58	198	2	2
Ouray	23	40,195	1,633.96	33,777	465,577	507,479
Park	12	5,348	6,925.27	143,158	51,023	55,615
Pitkin	11	125,786			625,444	681,734
Routt	1	3	2.13	44	100	109
Saguache	7	9,282	243.38	5,031	94,655	103,174
San Juan	19	201,671	12,904.81	266,766	746,100	813,249
San Miguel	14	374,169	64,833.43	1,340,226	1,064,667	1,160,487
Summit	26	48,328	19,606.58	405,304	106,422	116,000
Teller	41	448,618	209,173.40	4,323,998	33,789	36,830
Total, 1920	416	1,571,293	366,504.43	7,576,319	5,409,335	5,896,175
Total, 1919	464	1,919,768	478,265.58	9,886,627	5,758,010	6,448,971

[a] Includes placer production.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1920—Con.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Boulder	6,685	$1,230	261,088	$20,887	.....	.....	$226,774
Chaffee	28,195	5,188	396,250	31,700	283,235	$22,942	133,872
Clear Creek	61,978	11,404	2,457,100	196,568	372,420	30,166	526,369
Custer	28,033	5,158	171,562	13,725	.....	.....	57,020
Dolores	6,804	1,252	772,588	61,807	229,865	18,619	119,090
Eagle	517,109	95,148	282,538	22,603	6,653,235	538,912	986,996
Gilpin	86,603	15,935	435,012	34,801	.....	.....	187,985
Grand	.....	.....	525	42	.....	.....	975
Gunnison	.....	.....	958,301	76,664	1,530,691	123,986	247,125
Hinsdale	2,625	483	80,625	6,450	.....	.....	36,543
Lake	799,744	147,153	8,590,188	687,215	18,754,531	1,519,117	4,320,510
La Plata	.....	.....	937	75	.....	.....	22,625
Mineral	1,120	206	531,537	42,523	.....	.....	345,270
Moffat	.....	.....	.....	.....	.....	.....	118
Montrose	.....	.....	.....	.....	.....	.....	200
Ouray	86,881	15,986	1,334,575	106,766	.....	.....	664,008
Park	18,674	3,436	1,085,625	86,850	.....	.....	289,059
Pitkin	.....	.....	4,470,300	357,624	617,790	50,041	1,089,399
Routt	.....	.....	.....	.....	.....	.....	153
Saguache	88,386	16,263	150,063	12,005	.....	.....	136,473
San Juan	1,361,391	250,496	16,601,025	1,328,082	11,837,395	958,829	3,617,422
San Miguel	948,696	174,560	7,571,875	605,750	175,617	14,225	3,295,248
Summit	359	66	477,462	38,197	8,335,963	675,213	1,234,780
Teller	451	83	612	49	.....	.....	4,390,960
Total, 1920	4,043,734	744,047	46,629,788	3,730,383	48,790,742	3,952,050	21,898,974
Total, 1919	3,560,207	662,198	37,070,241	1,964,722	37,220,493	2,717,096	21,679,614

REVIEW BY COUNTIES.[1]

BOULDER COUNTY.

Central district.—The Central district (near Jamestown) produced 91 tons of smelting ore, carrying $1,197 in gold, 1,367 ounces of silver, 571 pounds of copper, and 20,725 pounds of lead, with a total value of $4,450, as compared with $20,804 in 1919. A car of gold ore was shipped from the Black Rose mine. The remainder came principally from small lots of lead-silver sulphide ore found in mining fluorspar.

Gold Hill district.—The Gold Hill district produced 216 tons of smelting ore, carrying $7,188 in gold, 9,278 ounces of silver, 1,098 pounds of copper, and 12,113 pounds of lead, with a total value of $18,472, as compared with $31,044 in 1919. One car of high-grade silver from the Victoria mine, half a car of high-grade silver from the Tippecanoe mine, and several cars of gold ore from the Baron mine were shipped. Other producing mines were the Colorado, Emancipation, Grace, Horsfal, Melvina, and Prussian.

Grand Island district (Cardinal, Caribou, and Eldora).—The Grand Island district produced 4,730 tons of ore, carrying $11,059 in gold, 50,433 ounces of silver, and 41,687 pounds of lead, with a total value of $69,366, as compared with $91,685 in 1919. The principal producing mine was the Caribou, from which lessees shipped small lots of high-grade silver ore. The Boulder County mine supplied several cars of good-grade gold and silver ore direct to the smelter and several thousand tons of low-grade ore, which was concentrated at the Boulder County gravity concentration and oil flotation mill

[1] For production by counties see table, pp. 574–575.

to several cars of a very good grade of gold-silver-lead concentrates. Other producers were the Blue Bird, Belcher, Congo Chief, Happy Home, Poorman, Potosi, and Wigwam.

Magnolia district.—Several small lots of ore aggregating 27 tons were shipped from the Magnolia district.

Sugar Loaf district.—The Sugar Loaf district remained the principal producing district in the county, having a yield of 10,610 tons of ore, carrying $20,195 in gold, 60,422 ounces of silver, 5,016 pounds of copper, and 28,225 pounds of lead, with a total value of $89,236, as compared with $124,660 in 1919. The principal producing mines were the Yellow Pine, from which silver ore was shipped to smelters by lessees; the Wood Mountain mine, from which gold ore was shipped to the Golden Cycle roast-cyanide mill at Colorado Springs and to smelter; the Logan mine, from which gold ore was shipped to the Golden Cycle mill and to smelters and gold bullion directly to the Mint; and the Forest-Concord-Ogallalah group, from which nearly 10,000 tons of silver ore was concentrated to several cars of silver concentrates in the new 100-ton gravity-concentration and oil-flotation mill by the Colorado United Mines Co. Other producing mines were the Doss and the Little Maxine.

Ward district.—The Ward district produced 3,802 tons of ore, carrying $643 in gold, 27,278 ounces of silver, and 158,338 pounds of lead, with a total value of $43,043, as compared with $51,577 in 1919. The White Raven concentration mill was operated the entire year, partly on low-grade ore from the White Raven mine and partly on dump material accumulated during the preceding seven years.

CHAFFEE COUNTY.

Chalk Creek district.—The Mary Murphy Gold Mining Co., operating the Mary Murphy mine and with a lease on the Iron Chest mine adjoining, continued to be the principal operator and shipper in Chaffee County. The Mary Murphy mill was idle, only smelting ore being mined and shipped. Lessees on this property did much development work on the 1,400-foot level without opening any large bodies of ore.

Cottonwood Creek district (Buena Vista).—A car of silver ore was shipped from the Gladstone mine, which was reopened in 1920 after a long idleness.

Monarch (Garfield) district.—From three mines in the Monarch district 1,461 tons of ore was shipped, carrying $432 in gold, 4,122 ounces of silver, 3,016 pounds of copper, 155,038 pounds of lead, and 283,235 pounds of zinc, with a total value of $40,825, compared with $67,107 in 1919. The producing mines were the Jewell group, Eclipse, and Madonna.

Turret district.—Several cars of copper oxidized ore were shipped from the Sedalia mine.

CLEAR CREEK COUNTY.

Alice (Yankee) district.—Development work on the Reynolds group and other claims in the Alice district resulted in the mining of several hundred tons of gold ore, which was milled in a small amalgamation-concentration mill in the district.

Argentine district.—Milling and smelting ores from the Centennial, Mary Etta, and Santiago mines yielded $2,841 in gold, 5,467 ounces of silver, 22,250 pounds of copper, and 71,838 pounds of lead, with a total value of $18,641, as compared with $20,118 in 1919.

Empire district.—In the vicinity of Empire lessees on the Bellevue-Hudson property shipped lead sulphide ore to the sampler at Idaho Springs. At the Golden Empire property several hundred tons of gold ore from the Denver City mine was milled in testing the newly constructed flotation mill. Development work at the Silver Mountain mine resulted in the mining of several narrow-gage cars of gold smelting ore and several cars of milling gold ore.

Griffith (Georgetown, Silver Plume) district.—The Georgetown-Silver Plume district produced from 17 mines 40,060 tons of ore, yielding $3,466 in gold, 111,967 ounces of silver, 1,837 pounds of copper, 1,491,637 pounds of lead, and 372,420 pounds of zinc with a total value of $275,345, as compared with $336,941 in 1919.

South of Georgetown, on South Clear Creek, the Colorado-Central 400-ton flotation mill was operated until May 9, 1920, on silver-bearing material from the Ocean Wave dump and the Colorado Central mine, in which some drifting and crosscut work was done. The Capital mill and mine, at Georgetown, were idle, but several narrow-gage cars of concentrates from 1919 operations were shipped in 1920. The Georgetown Tunnel & Transportation Co. sent about 100 tons of ore from the Clara B mine through its new flotation mill, shipping a lead-silver concentrate. At the St. George mine several cars of milling and smelting ore were mined and shipped in the course of continuing the adit and in crosscutting. Development work continued at the Sceptre mines, opened by a 3,200-foot adit.

At Silver Plume the Wasatch-Colorado Mining Co. continued drifting and stoping at the Mendota-Frostburg mine, operated its 85-ton gravity-concentration mill throughout the year, although on less than full capacity, and produced a considerable quantity of lead-silver concentrates and approximately an equal quantity of zinc concentrates, but stored the greater part of the zinc concentrates for future markets. Several cars of lead-zinc milling ore were shipped from the Smuggler and Terrible-Dunderberg mines.

Idaho Springs district.—The Idaho Springs district produced 9,267 tons of ore, carrying $30,516 in gold, 70,800 ounces of silver, 28,022 pounds of copper, and 665,075 pounds of lead with a total value of $166,050, as compared with $223,896 in 1919. Ore shipped through the sampler to smelters or direct to smelters amounted to 2,421 tons; 6,850 tons went to mills in the district.

The Argo, Combination, and Jackson custom mills were idle. The Newton and Hudson custom mills were operated part of the year.

In Gilson Gulch individual lessees continued operations at the Franklin mine for the first eight months. This mine was included in the consolidation effected by the reorganized Gem Mining Co., which took over the Gem mines, Newton mill, and electric-light plant in July and operated the properties the remainder of the year. A car of lead ore containing commercial quantities of gold and silver was shipped from the Arizona-Morning Star mine. A considerable

quantity of ore from the Idaho Bride was milled in the district, the product being lead-silver concentrates. Several hundred tons of ore was shipped from the Seaton mine. In Virginia Canyon small outputs were made from the Calvin and Crown Point Mines. Lessees of the Edgar mine continued to ship silver smelting and milling ore through the Big Five tunnel. On the south side of Clear Creek some ore was mined and milled from the Little Mattie, Lord Byron, and Stanley mines. From the Argo mine, on Ute Creek, a small lot of high-grade silver ore was shipped. A car of silver ore was shipped from the Almaden mine, on lower Fall River. The Hoosac Tunnel property was reopened, and several hundred tons of ore was treated at Hoosac mill, which had been remodeled by the addition of flotation cells.

Montana (Lawson, Dumont) district.—The Montana district from 8 mines produced 578 tons of ore, yielding $3,456 in gold, 15,744 ounces of silver, 9,135 pounds of copper, and 78,738 pounds of lead, with a total value of $28,597, as compared with $21,410 in 1919. From the Albro mine, at Dumont, copper-gold-silver ore was shipped directly to smelters and milling ore to the Hudson mill at Idaho Springs, which yielded gold bullion and copper-gold-silver concentrates. Lead-silver ore was shipped from the Blue Ridge, Commodore Tunnel, Comstock, Joe Reynolds, and Two American Sisters mines.

Trail Creek (Lamartine and Freeland) district.—The Brazil, Lamartine, and Turner mines produced 368 tons of ore, yielding $2,396 in gold, 4,200 ounces of silver, 560 pounds of copper, and 105,837 pounds of lead, with a total value of $15,544, as compared with $16,246 in 1919.

CUSTER COUNTY.

The principal producing mines in Custer County were the Black Friday, Maxine Elliott, and Passiflora, near Silver Cliff.

DENVER COUNTY.

The Globe lead-copper smelter plant was used only for the treatment of flue and bag-house dust for the recovery of arsenic, cadmium, and thallium. The General Chemical Co. continued to operate its sulphuric acid plant, using Colorado pyritic ores, but began buying Texas sulphur for future use.

DOLORES COUNTY.

Lone Cone (Dunton) district.—A car of gold-silver ore was shipped from the Emma mine.

Pioneer (Rico) district.—The Pioneer district has a variety of ores, but those shipped in 1920 were chiefly lead sulphide and lead-zinc sulphide. The Rico Wellington Co., operating the General Sheridan, Iron Rod, and other claims, was the largest shipper. This company's annual printed report says:

> Receipts for 1920 were, ore sales $49,394. * * * As stated in our last year's report, about the first of March a very nice body of ore was opened up 112 feet above the 700 level, or Mountain Springs tunnel, and we have since that time mined ore from this stope to the northwest for approximately 110 feet. At this point we struck a fault which cut our ore off entirely.

We have done 140 feet of crosscutting and sinking in an endeavor to pick this ore up again, but up to the present have not been successful.

From all indications the ore faulted downward and we have just completed a drift on the main level 400 feet to the northwest, from which point we have commenced an upraise to pick up, if possible, the faulted section of the ore. While we have every reason to believe that the ore will make beyond the fault, it will take some time to complete this raise and it might also be necessary for us to crosscut the country before locating the ore channel.

The southeast section of the mine was just recently turned over to lessees, as the ore shoot had become so small that it would not pay on company account.

Other producing mines were the Baltimore, Argentine, Pro Patria, and various claims of the Syndicate Co.

EAGLE COUNTY.

Battle Mountain (Red Cliff) district.—The Empire Zinc Co.'s holdings in the Battle Mountain district produced the larger part of the output. Other producing mines were the Alligator, Alpine, Ground Hog, Liberty, Little Courtney, Pursey Chester, Star of the West, and Wyoming Valley.

Brush Creek district.—An adit was being driven to cut under the surface workings of the Lady Belle-North Dakota group.

EL PASO COUNTY.

At Colorado Springs the Golden Cycle 1200-ton roast cyanide mill was operated steadily, but not at capacity, chiefly on ores from the Cripple Creek district but also on small lots of ore from Boulder County and several thousand tons from Leadville. The Portland Co.'s mill was dismantled.

FREMONT COUNTY.

Because of its resources of coal and its railroad connections, Fremont County has always been a smelting or milling center for Colorado ores. In 1920 the Ohio zinc oxide plant, at Canon City, was operated until early in December on zinc carbonate ores from Leadville and from camps in Utah and Nevada. The Empire Zinc Co. constructed and set in motion as a trial a very modern zinc oxide plant, at Canon City, where is situated also that company's magnetic separation plant, which has been successfully operated for many years on Leadville zinc sulphide ores. The separation plant was closed in December, 1920. The River Smelting & Refining Co.'s plant at Florence for the treatment of low-grade copper-lead-zinc ores by the matting and fuming process was operated until December.

GILPIN COUNTY.

Southern districts (Black Hawk, Central City, Nevadaville, Russell Gulch).—Nearly all the amalgamation and concentration mills in the southern districts were idle in 1920. Some Gilpin County milling ores were hauled to Idaho Springs for treatment. Repairs were made on the U. P. R. (Buell) mill in preparation for resumption of operation in 1921. The Iron City mill was used by the Midwest Co. The Eureka mill was operated on Eureka ores only. The Polar Star amalgamation mill was operated intermittently.

Within the limits of the town of Central City the East Boston-Rialto mine was reopened.

In the Enterprise district, below Black Hawk, lead-silver ore was shipped from the Wheeler (Bryan Tunnel), Black Jack, Champion, Little Kingdom, and Mascot mines.

The only producing mine in the area embracing Gunnell Hill and Eureka and Prosser gulches was the Eureka. Owing to the idleness of the Argo mill and Argo tunnel at Idaho Springs, the Concrete and Gunnell mines were idle.

Production in the area embracing the town of Black Hawk and Gregory, Bobtail, and Bates hills was confined to small lots of ore from the Gilpin-Orion, Homer, Klein-German, Lucky No. 2, Mary Miller, Mohaska, O'Neil, and Running Lode.

Mines in the area embracing Illinois and Leavenworth gulches and the eastern portion of Quartz Hill were idle.

Producing mines in the Lake Gulch district were the East Notoway and Vivian-Notoway.

In the vicinity of Nevadaville small lots of ore were mined from the Ophir-Burroughs and West Baker.

In the Quartz Valley district some production was made from the Gold Cup, Hayseed tunnel, and Maggie M.

In the Russell Gulch district producing mines were the Becky Sharpe, Big Six, Druid, Fairfield, Frontenac, Hampton, Powers, and Springdale.

In the Hughesville-Hawkeye district, north of Black Hawk, the Midwest Co., operating the Cyclops, Alaska, and others, continued development work, shipped ore to smelters, and sent its milling ore to the Iron City mill.

Northern districts.—In the Silver Creek district, near Apex, the Cornucopia Co. continued development work on the Reform group and used the old 10-stamp mill as a pilot mill for tests to determine the process for a new mill. Development work was continued at the Evergreen mine, at Apex.

In the Independence district the Perigo mines and mills were operated for a short time by lessees, and the Smuggler mine was also operated for a short time.

GRAND COUNTY.

A small lot of high-grade silver ore was mined from the Ready Cash mine, in the Williams Fork district.

GUNNISON COUNTY.

Elk Mountain district.—Lessees on the Doctor mine, on Spring Creek, from January to November shipped a considerable quantity of zinc carbonate ore. A small lot of silver ore was shipped from the Ruby mine, near Crested Butte.

Gold Brick district (Ohio City).—Several hundred tons of gold-silver ore was shipped from the Carter mines, and a car of similar ore from the Chicago-Climax mine.

Tomichi district (Whitepine).—The Akron mine was operated continuously and the mill through January, February, and March and again from September through December. A considerable quan-

tity of zinc-lead ore was shipped to smelters, but only the lead concentrate product was shipped from the mill operations. A few cars of lead-zinc ore were shipped from the Victor mine.

HINSDALE COUNTY.

In the vicinity of Lake City small shipments were made from the Belle of the West, California, Excelsior, Fanny Fern, Golconda, Ilma, Pelican, Ute, and Wyoming mines. The ore from the Golconda mine assayed well in gold and silver, and the ore from the Fanny Fern carried a very appreciable content of silver.

JACKSON COUNTY.

The mines and prospects in the Pearl district were idle.

JEFFERSON COUNTY.

The prospects lying between Mount Vernon Canyon and Bear Creek and those near Evergreen were idle.

LAKE COUNTY.

In Lake County both placer gold and deep-mine gold showed an increase. The placer increase came from the Derry Ranch dredge, and the deep-mine increase from high-grade pockets of gold smelting ore uncovered in the Ibex mine. All other metals showed decreases. The quantity of ore under discussion in this report (not including the iron-manganese[2] (silver) ore used in the steel industry) mined in 1920 was 44,679 tons less than in 1919. All sulphide ores decreased in quantity, zinc-iron-lead ores showing the heaviest decrease; the only increases of importance were in iron-manganese-silver flux oxide ores and dry siliceous oxide ores. The dry siliceous oxide ores also showed heavy increases in gold and silver content.

This county continued to rank first in the production of silver and zinc, was closely pressed by San Miguel County in the production of silver, gave way to San Juan County in the production of lead, was third in the production of copper, and held its place as third in production of gold.

LEADVILLE DISTRICT.

GENERAL FEATURES.

Of the 172,988 tons of ore mined in Lake County 171,362 tons came from the Leadville district. The yield was $625,474 in gold, 1,037,100 ounces of silver, 798,897 pounds of copper, 8,557,400 pounds of lead, and 18,754,531 pounds of zinc, and the total gross calculated value was $4,106,619 out of a county total of $4,320,510. In 1919 the value was $4,673,448 out of a county total of $4,808,556; in 1918 it was $9,180,062 out of a total of $9,381,610.

[2] Whether the iron-manganese ore goes to a lead smelter or to a steel mill depends on the demand for manganese and, of course, on the grade of the manganese. Otherwise the ores are much the same.

Classification of Leadville ores in 1920.

Character.	Short tons.	Percentage.
Sulphide:		
Siliceous sulphide (carrying pyrite)[a]	21,702	12
Iron (pyrite with gold, silver, copper, and lead, and some zinc blende)	33,718	20
Zinc-iron-lead (zinc blende, pyrite, and galena)[a]	30,899	18
	86,319	50
Oxide:		
Lead (iron excess)	694	.....
Lead (silica excess)	17,826	11
Iron flux	1,990	1
Iron-manganese-silver flux	37,934	22
Siliceous	9,873	6
Zinc	16,726	10
	85,043	50
Grand total	171,362	100

[a] The greater part of the pyrite ore carries iron in excess of silica and also high silver but low gold content. A large quantity (21,702 tons) carries silica in excess (over iron) and gold of greater value than silver. Some of the pyrite ore approaches the zinc-iron-lead classification (and becomes such when zinc market gives higher returns for sale as lead-zinc sulphide than as lead sulphide to lead smelters and vice versa).

Character.	Quantity.	Recovered content.				
		Gold.	Silver.	Copper.	Lead.	Zinc.
Sulphide:	*Short tons.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*
Copper (excess silica)	2,011	1,219.00	49,920	158,181	13,156	.....
Lead siliceous	411	24.80	2,798	5,109	150,769	.....
Siliceous (carrying pyrite)	19,280	10,614.80	166,487	330,470	471,958	.....
Iron pyrites[a]	33,718	2,337.70	219,907	153,905	1,319,004	.....
Zinc-iron-lead	30,899	[b] 303.35	[b] 68,626	[b] 40,004	[b] 1,498,581	[c] 12,923,696
Oxide:						
Lead (iron excess)	694	68.80	6,288	272	119,452	.....
Lead (silica excess)	17,826	1,354.60	141,055	92,361	3,666,124	.....
Iron flux	1,990	384.00	9,678	507	83,596	.....
Iron-manganese-silver flux	37,934	90.70	270,431	.....	1,043,668	.....
Siliceous	9,873	12,168.70	101,282	18,088	191,092	.....
Zinc	16,726	.....	.....	.....	.....	5,830,835
Metallics (sulphide and oxide)[d]	.....	1,690.85	628	.....	.....	.....
	171,362	30,257.30	1,037,100	798,897	8,557,400	18,754,531

[a] Includes both ore to lead plants and ore used for making sulphuric acid from which residues were returned to lead plants.
[b] Recovered as lead and iron concentrates in zinc residues. Much lead recovered in leaded-zinc oxide.
[c] Zinc in terms of recovered retort zinc and recovered zinc in zinc oxide.
[d] Includes much Cripple Creek and Park County metallics.

Character.	Average recovery.				
	Gold.	Silver.	Copper.	Lead.	Zinc.
Sulphide:	*Ounces per ton.*	*Ounces per ton.*	*Per cent.*	*Per cent.*	*Per cent.*
Copper siliceous	0.606	24.82	3.93	0.33	.....
Lead siliceous	.060	6.81	.62	18.34	.....
Siliceous (carrying pyrite)	.551	8.64	.86	1.22	.....
Iron	.069	6.52	.23	1.96	.....
Zinc-iron-lead	[e] .025	[e] 4.00	.....	[e] 4.44	[f] 27.13
Oxide:					
Lead (iron excess)	.099	9.06	.02	8.61	.....
Lead (siliceous excess)	.076	7.91	.26	10.28	.....
Iron flux	.193	4.86	.01	2.10	.....
Iron-manganese-flux	.002	7.13	.....	1.38	.....
Siliceous	1.233	10.26	.09	.97	.....
Zinc	.....	.....	.....	.....	[f] 21.79
Metallics (sulphide and oxide)	.....	.....	.....	.....	.....

[e] Average original assay of that part of original ore for which data were available.
[f] Average assay of original content; no deductions for loss in smelting. All to zinc plants.

During 1920 the A. Y. smelter of the American Smelting & Refining Co. was operated steadily but at less than half capacity on Colorado, Idaho, Utah, and other ores. The Western zinc-oxide plant was operated steadily on Leadville low-grade zinc carbonate ores.

The Downtown Mines Co. continued to ship heavily from the properties unwatered in 1916, but only part of the upper levels of the Western Mining Co.'s properties were worked; the Mikado shafts remained idle; lessees did some work on the Iron-Silver groups; the Ibex continued because of several strikes of exceptionally high-grade gold ore; and operations were continued at the Gambetta, Dunkin, Robert E. Lee, and Yak mines.

MINES REVIEW.

California Gulch, Iron Hill, and Breece Hill mines as unwatered by the Yak tunnel.—Under the management of the Yak Mines, the Yak tunnel continued to be the outlet for production from the Cord, Colonel Sellers Fraction, Dolly B., Habendum, Henry, Howard, Hugh, Rubie, North Tenderfoot, Ollie Reed, White Cap, and Winnie. Most of the large quantity of ore from the tunnel was zinc-lead-iron-silver sulphide ore, and there were also dry silver pyrite ores, dry silver siliceous sulphide ores, and some lead-silver siliceous oxide ores. In addition, several thousand tons of pyritic ore was sold for its sulphur content to manufacturers of sulphuric acid, the residues containing gold and silver being returned to lead smelters.

Iron Hill and North Iron Hill.—Lessees on the property of the Iron Silver Mining Co. produced 19,998 tons of ore yielding a net return of $117,953, from which the company received $13,028 as royalty payments and $3,221 from other charges. The bulk of this ore came from the lease on the Moyer mine, and the most of the Moyer ore was iron sulphide ore containing no precious metals and marketable for its sulphur content.

Ore produced by Iron Silver Mining Co., 1920.

Class of ore.	Short tons.	Net value.
Zinc-lead sulphide	2,321	$18,115
Zinc sulphide	2,844	24,693
Iron sulphide	12,026	57,809
Iron oxide	2,073	11,517
Zinc carbonate	674	4,469
Lead carbonate	60	1,350
	19,998	117,953

Lessees on the A. Y. & Minnie mine shipped lead-silver-iron sulphide, zinc-lead sulphide, and zinc carbonate ores. Lessees on the Adelaide and Humboldt mines shipped siliceous oxide ore carrying silver and some lead.

Graham Park.—The Graham Park holdings of the Iron Silver Mining Co. remained idle during 1920. Water rose during 1920 in the Pyrenees shaft to 670 feet below the collar. Several cars of zinc carbonate ore were mined from properties controlled by the Mikado

lease. The Greenback mine also remained idle. A large quantity of zinc carbonate ore was shipped from the Blaine Shaft of the Forest City mine.

Ball Mountain.—Lead-silver ore was shipped from the Sunday mine.

Breece Hill.—The principal gold mines of the Leadville district are on Breece Hill and in South Evans Gulch. Lessees on the property of the Ibex Co. continued to ship large quantities of all grades of Leadville ore, including some extraordinary high-grade gold smelting ore and some metallic gold. Several thousand tons of pyritic gold ore was shipped on trial to the Golden Cycle cyanidation mill from the Ibex mine, and also several thousand tons for experiment to the Leadville district flotation mill. Operations by the Garbutt Leasing Co. on the Garbutt and adjoining properties were greatly lessened. Another producer was the Fanny Rawlings, from which a copper sulphide ore was shipped assaying well in gold and silver and carrying silica in excess of iron.

South Evans Gulch and Little Ellen Hill.—Zinc-lead sulphide and other ores were shipped from the New Monarch mine by lessees. Several cars of lead-silver-gold ore were shipped from the Valley (Luema) mine.

Carbonate Hill.—The Western Mining Co. did no work in 1920 on its holdings, but lessees on the upper levels mined zinc carbonate, iron-manganese-silver fluxing, and lead carbonate ores. Lessees on the Catalpa, Crescent, Morning Star, Evening Star, and Yankee Doodle shipped large quantities of iron-manganese-silver ore as flux to lead smelters and iron-manganese ore to steel plants. High-grade iron-manganese ore was shipped to steel mills from the Carbonate mine.

Fryer Hill and Stray Horse Gulch.—Iron-manganese-silver fluxing ores were shipped from the Chrysolite, Dunkin, and Seneca. Oxide ore carrying silver was shipped from the Forepaugh, Harvard, Little Chief, Little Sliver, Matchless, and Robert E. Lee, and pyritic silver ore from the Gambetta. Zinc carbonate ore was shipped from the Denver City-Shamus O'Brien mine.

Poverty Flats district.—Iron-manganese ore was shipped to steel mills from the Jason mine.

Printer Boy Hill.—Lessees on the Lillian shipped a small specimen of metallic gold, and a considerable quantity of lead-silver oxide and zinc carbonate ores.

Rock Hill.—Lead-silver oxide ore was shipped to the A. V. smelter from the La Plata, and a car of iron-manganese ore to steel mills from the Emmett.

Iowa Gulch.—A considerable quantity of siliceous oxide ore carrying silver was shipped from the Long & Derry mine.

Downtown district.—From the properties under the control of the Down Town Mines Co. worked through the Penrose shaft, were shipped large quantities of ore, the bulk being oxide, including lead oxide, lead sulphide, lead-zinc sulphide, zinc carbonate, iron-manganese-silver flux, and iron-manganese (to steel mills) ore. The A. V. mine was operated for eight months and shipped a considerable quantity of high-grade iron-manganese ore to steel plants.

OTHER DISTRICTS.

St. Kevin, Sugar Loaf, and Independence districts.—Silver ore was shipped from the Dinero, Gertrude, Griffin, and Prince of Wales.

Arkansas River dredge district.—Several miles above the mouth of Rock Creek, 12 miles below Leadville, the Derry Ranch dredge, with buckets of 5 cubic feet capacity each, continued successful operations in 1920.

Tennessee Pass district.—A small button of placer gold was sluiced from the Ewing placer from bench gravels.

LA PLATA COUNTY.

All the ore produced in La Plata County was shipped direct to smelters. The chief producers were the Jumbo, May Day, and Valley View, in the La Plata district.

MINERAL COUNTY.

Creede district.—Creede is the center for the producing area of Mineral County. The ore is chiefly siliceous and carries silver and some gold and lead. In 1920 the output of silver decreased 26 per cent, following a 42 per cent decrease in 1919. Producing mines in 1920 were the Amethyst, Bachelor, Commodore, Del Monte lease (New York and Chance), Manitoba, and Creede-Quintette (Wabash Co.).

MOFFAT COUNTY.

A few ounces of placer gold was sluiced from gravels in the Fourmile district, south of Baggs, Wyo.

MONTROSE COUNTY.

Several ounces of gold was sluiced from Luhr's placer, 23 miles down San Miguel River from Naturita, on Dolores River.

OURAY COUNTY.

Red Mountain district.—The Red Mountain district from 6 mines produced 3,196 tons of ore, yielding $2,655 in gold, 13,056 ounces of silver, 51,533 pounds of copper, and 279,312 pounds of lead, with a total value of $48,713, as compared with $73,062 in 1919.

Lessees on the Barstow mine worked steadily until August when they stopped work in the Barstow and worked the continuation of the Barstow vein in the adjoining Imogene claim, through No. 1 level of the Barstow. The ore mined was all milled in the amalgamation, gravity concentration, and oil flotation mill on the property. Several cars of high-grade copper ore were shipped to Garfield, Utah, from the Guadalupe mine. Much development work was done at the Red Mountain mines, consisting of the well-known Joker Tunnel, Genesee-Vanderbilt, Yankee Girl, and Robinson claims, up to the closing of the property in October, 1920. Several thousand tons of material was concentrated to a marketable lead-silver concentrate.

Sneffels district.—The Sneffels district from 6 mines produced 36,248 tons of ore, yielding $25,185 in gold, 416,967 ounces of silver, 32,946 pounds of copper, and 1,033,725 pounds of lead, with a total value of $568,439, as compared with $758,128 in 1919.

The Atlas 100-ton 20-stamp gravity-concentration and oil-flotation mill was operated steadily but with a reduced crew for the first six months. The product from this mill is a lead-silver concentrate. Several cars of lead-silver ore were shipped directly to the Pueblo smelter from the Hidden Treasure mine. The Humboldt mine was operated only three months in 1920. This mine is operated from the Telluride side of the mountains, through the Smuggler Union Mining Co.'s workings, and all ore was milled at the Smuggler Union mill. The ore treated and content recovered are credited to Ouray County. The Mountain Top mine was operated 366 days, and the 50-ton gravity-concentration and oil-flotation mill was operated 238 days. A high-grade silver concentrate is the product of this mill, and in addition picked ore of even higher grade than the concentrate is shipped direct to smelters. The exploratory work at the bottom of the Camp Bird has opened "nothing of sufficient magnitude to justify milling operations," which ceased in June, 1916.

Uncompahgre district.—The Uncompahgre district produced from 12 mines 751 tons of ore, yielding $5,937 in gold, 35,554 ounces of silver, 2,402 pounds of copper, and 21,538 pounds of lead, with a total value of $46,856, as compared with $81,189 in 1919. The principal producing mine continued to be the Wedge, from which several hundred tons of silver ore was shipped. Several cars of pyritic ore carrying gold were shipped from the Bright Diamond mine. Other producing mines were the Bachelor-Khedive, Black Girl, El Mahdi, Little Maudie, Neodesha, Newsboy, Portland, Raven, and Senorita.

PARK COUNTY.

Buckskin district.—No ore was shipped, but some development work was done in the Buckskin district in 1920. The Buckskin placer was equipped with flumes, pipe line, and nozzles for hydraulic mining in 1921.

Consolidated Montgomery district.—No work was done at the Dolly Varden mine in 1920, except to keep the mine open, and one car of crude ore and a remnant of concentrate from operations in 1919 were shipped during 1920. One car of silver ore was shipped from the Russia mine.

Fairplay district.—Preparations were made for the construction in the Fairplay district of the hull of the dredge to be installed for the handling of the placer area upon which testing and drilling has been done during the last three years.

Hall Valley district.—A car of copper-silver ore was shipped from the La Clede-Missouri mine. Several hundred tons of ore from the Whale mine was concentrated into several cars of lead-silver concentrate in the 50-ton gravity-concentration and oil flotation mill.

Horseshoe district.—As a result of the development work done in 1919, several thousand tons of lead-silver oxidized ore was shipped from the Hill Top mine, which was operated 366 days. In addition to much development work and stoping of ore, 11 miles of railroad

branch was built and tramway and buildings were repaired. A car of silver ore was shipped from the Mudsill mine.

Mosquito district.—From two openings on the Gold Wave mine were made two small shipments, one of high-grade gold ore and one of fair-grade silver ore. Lead ore containing silver and some gold was shipped from the Hock Hocking mine. A car of silver ore was shipped from the Kennebec mine. The London mine continued as a producer of a large quantity of high-grade gold ore.

Tarryall district.—Lessees on the Fortune placer recovered by hydraulicking a small quantity of bullion averaging gold 0.821 fine and silver 0.108 fine.

PITKIN COUNTY.

Aspen (Roaring Fork) district.—The Smuggler Leasing Co. continued to ship large quantities of mixed lead-silver oxidized and sulphide ores, also zinc-lead sulphide and zinc-lead oxidized ores direct to smelters, and sent a large quantity of dry silver ores to the Smuggler mill, the product of which was lead-silver concentrate, low in lead but carrying a marketable content of silver. This lease covers the properties of the Smuggler, Compromise, Late Acquisition, and Mollie Gibson companies. The zinc-lead oxidized ore came from Lenado, about 6 miles from Aspen. The Smuggler mill also received milling ore from the Pride of Aspen mine. Several hundred tons of ore carrying silver with a lime gangue was shipped to smelter from the Aspen Fraction mine. Silver ore was shipped direct to the smelter from the Millinee and Spar groups. The Hunter Creek mill was operated steadily on material from the dump from the Cowenhowen adit. Much development work was done on the claims of the Hurricane Co., and one car of lead-silver ore was sold to the Aspen sampler. The Newman group, opened by an adit 4,500 feet long, yielded several thousand tons of lead-silver ore and several thousand tons of silver ore containing some lead. The Park Tunnel Mining & Milling Co., controlling a large area in Tourtelotte Park, opened by two adits—one 2,970 feet and one 1,200 feet in length—carried on continuous development work in 1920 and shipped several hundred tons of silver oxidized ore. The Richmond Hill Mining, Milling & Leasing Co., a sublessee on certain claims of the Hope Mining, Milling & Leasing Co., mined through a 1,700-foot adit several thousand tons of silver ore and treated it in the Richmond Hill 50-ton gravity-concentration and oil-flotation mill, shipping a lead-silver concentrate. The Hope Mining, Milling & Leasing Co., a local pool, continued to drive its crosscut to cut the Little Annie and other mines at a depth of 2,200 feet.

ROUTT COUNTY.

A small lot of gold-silver ore was shipped from the Royal Flush mine, in the Hahns Peak district.

SAGUACHE COUNTY.

Blake district (Mirage).—A car of gold-silver ore was shipped from the Bob Lee claim, on Cotton Creek.

Crystal Hill district.—Lessees, from January to September, shipped several hundred tons of silver ore from the Esperanza mine, north of Del Norte and west of Moffat.

Kerber Creek (Bonanza) district.—There was an appreciable increase in the production of the Kerber Creek district in 1920. Several cars of lead-copper-silver ore were shipped from the Antoro mine. Under the title of the Antoro Mines Co., several groups of claims were taken under bond and lease, preliminary surveys were made, and development work was done. From the Cocomongo mine a large quantity of ore was sent to the Bonanza 50-ton gravity-concentration and oil-flotation mill, the product being lead-copper-silver concentrate. In addition several hundred tons of copper-silver ore was shipped directly to smelters. At the Eagle mine, opened by a 450-foot vertical shaft and 2,000 feet of drifts, several thousand tons of ore was stoped and, with the addition of several thousand tons from the dump, was milled in the 50-ton oil-flotation mill on the property. The concentration ratio was high, but the resulting concentrate carried a high content of silver. Development for examination of the Liberty mine resulted in the shipment of several cars of mixed oxide and sulphide ore carrying silver. No ore was mined at the Rawley mine, which has remained idle for several years since the completion of an adit 6,235 feet long that cut the vein at 1,200 feet in depth and exposed an ore body upon which some drifting has been done.

SAN JUAN COUNTY.

The production of San Juan County for 1920 was the largest in gross value in the history of the county.

Animas district.—The Animas district (including the mines in the vicinity of Silverton and south and east of Animas River from Silverton to Middleton) did not equal its record for 1919. The largest operation was that of the Southwestern Leasing Co. on the Iowa-Gold Tiger group and gravity-concentration and oil-flotation mill, to which was sent a large quantity of milling ore that yielded a very good grade of lead concentrate carrying gold and silver. Two other important operations were the Dives and the Highland Mary, from which were shipped appreciable quantities of lead ore assaying well in silver. Lessees on the Silver Lake mines extracted several hundred tons of lead-silver ore. Other producing mines were the Champion No. 1, Colombo, Emerald, Fredericka, Hercules, Little Nation, and San Juan Queen.

Eureka district.—The Eureka district (north of Silverton, including Chattanooga, Animas Forks, Eureka, and Red Mountain) made a greatly increased output. The Sunnyside Co. operated continuously its 500-ton gravity-concentration and selective-flotation mill, producing a high-grade lead concentrate carrying marketable quantities of gold, silver, and copper and a comparatively high-grade zinc concentrate carrying appreciable quantities of lead, copper, silver, and gold. A comparatively large quantity of gold ore was milled at the Gold King 80-stamp amalgamation and gravity-concentration mill and yielded gold bullion and gold concentrates. A car of copper ore carrying silver and gold was shipped from the Early Bird discovery. Two cars of chalcopyrite-pyrite ore carrying silver and gold were shipped from the Henrietta mine, near Red Mountain.

Ice Lake Basin district.—Several cars of lead-silver-gold ore were shipped from the Bandora mine by lessees.

SAN MIGUEL COUNTY.

Iron Springs (Ames and Ophir) district.—The Iron Springs district in 1920 produced 2,788 tons of ore, carrying $1,906 in gold, 32,111 ounces of silver, 12,082 pounds of copper, and 278,500 pounds of lead, with a total value of $61,410, as compared with $63,792 in 1919. Several hundred tons of lead-silver sulphide ore was shipped to Durango from the Carbonero mine. The ore from this mine also carries some zinc. The Valley View Co. completed its 100-ton Gravity concentration and oil-flotation mill at the San Bernardo property and started milling operations during the last months of the year, shipping several hundred tons of silver concentrate. The Matterhorn Mining & Milling Co. took an option on the mine and mill of the Butterfly-Terrible property and shipped one car of lead-copper ore to the Durango smelter. One car of lead-silver ore was shipped by lessees from material sorted from the dump of the Silver Bell property. Shipments of crude ore to Durango were also made from the Crown Point, Favorite, and Santa Cruz properties.

Upper San Miguel district.—The Upper San Miguel district produced 371,381 tons of ore, carrying $1,338,320 in gold, 1,032,556 ounces of silver, 936,614 pounds of copper, 7,293,375 pounds of lead, and 175,617 pounds of zinc and having a total value of $3,233,838, as compared with $3,887,094 in 1919.

The Belmont-Wagner Mining Co., operating the Alta and St. Louis mines, with a main adit of 4,000 feet and 4 miles of drifts, ran its 300-ton oil-flotation mill (followed by table concentration) from January to April and in September and October on crude ore from the mine and some tailings from previous operations, shipping lead-silver-gold concentrates. The ore from this property is both oxidized and sulphide; oxidized ores persist even in the lowest workings.

The Cimarron 40-stamp table-concentration mill was operated for a short period, with shipments of gold concentrate.

The complex lead-zinc sulphide ore of the Black Bear mine was treated in the Smuggler Union mill with two products, a lead-copper-silver-gold concentrate sold to the Durango smelter and a zinc-lead-silver-gold concentrate sold to the River smelter, at Florence.

The Liberty Bell 500-ton concentration-cyanidation mill was not in operation for four months. In September the cyanide treatment was discontinued, and for the rest of the year concentration only was applied to the ore, the reserves of which were seen to be small.

The Smuggler Union 60-stamp 650-ton amalgamation-concentration mill treated approximately the same tonnage from the Smuggler Union proper as in 1919, and also treated ore from the Black Bear mine, in San Miguel County, and the Humboldt mine, in Ouray County. Lessees working on the upper levels of the Smuggler Union also contributed to the output by operating the 30-ton Barbara mill, equipped with a ball mill, Huntington mill, and tables, with product of amalgam bullion and gold-silver concentrate.

The Tomboy new 600-ton oil-flotation plant was put into full use in January, but during the first six months of the year, except in March, the operation showed financial losses, due principally to the difficulties of starting a new plant and the adjustment of the treatment of the varied ores.

The annual report of the Tomboy Gold Mines Co. (Ltd.), dated London, December 4, 1920, for the year ended June 30, 1920, but including the report of the manager, dated New York, October 20, 1920, continues as follows:

The failure of the plant to produce a merchantable zinc product, which was one of the objects of its installation, accentuated these difficulties, and it was the treatment of much larger quantities of zinc ore, in pursuit of this object, that caused the serious losses in May and June. The endeavor to produce a profitable zinc concentrate has, at least for the present, been abandoned, and the plant is now working satisfactorily and has made continuous profits since July 1.

During the year 55,607 tons of ore were drawn from the Argentine mine, leaving 301,586 tons in reserve, of which 132,346 tons are broken in the stopes and ready to be drawn; 90,458 tons of ore * * * was drawn from the workings of the Montana group, leaving an estimated reserve of 586,658 tons, of which 189,136 tons are still unbroken.

Revenue and expenditure, Tomboy mine, June 30, 1919, to June 30, 1920.

146,066 dry tons ore milled, yielding amalgam bullion worth			$107,919.72
Concentrates worth			672,735.18
Cyanide bullion worth			28,646.97
Cyanide slag worth			2,687.68
			811,989.55
Sundry profits—boarding house, rents, etc			4,205.29
			816,194.84
	Per ton.		
Mining and developing expenses	$2.96	$432,556.71	
Milling expenses	.68	98,894.16	
Concentrating expenses (including transportation to railway)	.76	110,773.10	
Water-supply expenses	.20	29,719.71	
Assay-office expenses	.05	7,552.79	
Cyaniding expenses	.11	15,270.67	
60-mill clean-up expenses	.01	861.75	
General expenses	.49	71,502.03	
Taxes and insurance	.33	48,724.14	
Total expense	5.59		815,855.06
Profit			339.78

During the period under review the operations in mining and treatment of ore from the property have been handicapped by the change from the former method of reduction to that of oil flotation. This change led to the shutdown of the cyanide plant in July, 1919, for the purpose of remodeling it to suit the new system, also the abandonment of the 60-stamp mill early in December, 1919. As a result, both the tonnage of ore treated and the values recovered suffered severely, and this, added to the present high cost of construction and operation, put an undue strain on the company's resources.

The new flotation plant, erected to treat 15,000 tons of ore monthly, was able during the month of September, 1920, to handle 17,432 tons. It is a very efficient installation and the elasticity of its capacity is an important matter, as advantage can be taken of the periods when water is plentiful to treat the maximum tonnage.

The system of shrinkage stopes, adopted in mining the Argentine ore, was so economical and resulted so well, that the late management was induced to apply it in the Montana mine but owing to the softer walls in the Montana vein, it is found that ore stoped in this method, after long exposure, became vitiated by waste rock from the walls. It has therefore been decided to

apply this system only where local conditions warrant, and generally waste-filled stopes or other methods will be adopted. This change, though more expensive, will result in cleaner ore going to the mill.

Since the connection was made between the surface workings of the Sidney and the Ophir level, nothing has been done to develop either the Sidney vein or the extension north of the Montana vein. No records are available as to former Sidney operations, but it is known that ore of a good grade was met with, and development of this section is contemplated, as soon as labor is available.

SUMMIT COUNTY.

There were increases in deep-mine production of gold, silver, lead, and zinc in Summit County in 1920. Dredges and other placer operations yielded $374,882 in gold and 4,811 ounces of silver, as compared with $464,540 in gold and 5,942 ounces of silver in 1919.

Breckenridge district.—The value of the total output of Breckenridge district from both deep and placer mines was $1,141,194, or 92 per cent of the county yield.

The Wellington mine continued to be the principal producing mine in the district. The Wellington mine has two mills, one a 115-ton wet-concentration mill, making a lead concentrate, zinc-iron middling and silica tailing, and a 90-ton magnetic separator for treatment of the middling, making a zinc concentrate and an iron tailing. These two mills were operated nearly at capacity in 1920, and a large quantity of zinc concentrate was shipped. Several hundred tons of crude pyritic ore was also shipped during the year for its sulphur content.

Other producing mines were the Brooks-Snyder, Dunkin, Iron Mask-Etta, Germania, Jessie, Minnie B., Missouri, Price, Quandary Queen, I. X. L. (Royal Tiger Co.), and Standard.

Four dredges were in operation during the year. The Blue River Placer Mining Co.'s dredge of 70 buckets of 8 cubic feet capacity each was operated on the B. & L. and other placer claims. The French Gulch Dredging Co.'s dredge of 80 buckets of 5 cubic feet capacity each was operated from April 20 to September 29. The annual report of the Tonopah Placers Co. (subsidiary of the Tonopah Mining Co. of Nevada) reports only two of its three dredges in operation in 1920, as follows:

> Dredge No. 1 has continued operating during the year on the Magnum Bonum placer. This dredge handled 1,340,876 cubic yards of material during the year, giving a total production of $169,122, or an average value of 12.6 cents per yard with a net operating profit of $66,280, or 5 cents per cubic yard. In conformity with the annual custom, this dredge will be closed down the first of February, so that the necessary repairs can be made upon it for the coming season. It is probable that this dredge will have about four or five years' more operations. During the past year the company acquired a parcel of the Magnum Bonum placer and the Rankin placer, adding about 27 acres of available dredging ground for this dredge. For the coming year the ground ahead of No. 1 dredge should average about the same as 1920, but the operations of this dredge will be obliged to carry all the overhead charges formerly distributed over the three dredges.
>
> As stated in the annual report for the year 1919, the operation of No. 2 dredge was suspended in December of that year and has continued to be closed down during all the year 1920. Owing to the location of this dredge, it could not be utilized unless it was dismantled and transported to another part of the property. The cost of the necessary repairs to put it in proper working condition, together with dismantling and moving it, would be too large to make it advisable to do so. Therefore the dredge should be dismantled and such parts

of the dredge and material thereon as can be utilized in making repairs to No. 1 dredge during the coming season should be appropriated to this purpose, and the balance of the material disposed of to the best advantage. By using the material from this dredge in making repairs to No. 1, a considerable saving can be effected over the purchase of such material in the market at the present time.

Dredge No. 3 has been operating during the past year upon ground leased from the Long Island Mining Co. Its operation was suspended in the early part of December, since it had reached a point where further operation proved to be unprofitable. Therefore it was deemed advisable that this dredge be dismantled at its present location and the material disposed of to the best advantage.

Production and income statement of Tonopah Placers Co., for the year 1920.

Surplus, Dec. 31, 1919		$99,295.99
Deduct: Cost of leasehold right to dredge property of Long Island Mining Co., chargeable to net income for 1919		10,000.00
		89,295.99
Net earnings and income for year 1920:		
Gross value of bullion shipped to Mint	$233,661.96	
Cost of operations	181,007.61	
Profit from operations	52,654.35	
Other income	3,328.71	
Net income for year 1920		55,983.06
		145,279.05
Charges against profit and loss account:		
Reserve for depletion—10 per cent on cost of property and 10 per cent on plant and equipment for year 1920		177,484.39
Excess of depletion for 1920, over surplus, written off against capital stock		32,205.34
Cubic yards dredged		1,791,143
Gold produced	ounces	11,008.96
Silver produced	do	3,026.27
Value per yard		$0.13

Sluicing on the Bemrose-Bostwick and hydraulicking on the Washington placer recovered a small quantity of gold.

Consolidated Tenmile (Frisco, Kokomo, and Robinson) district.—The Consolidated Tenmile district produced from 3 mines 9,533 tons of ore, carrying $15,535 in gold, 58,200 ounces of silver, and 21,337 pounds of lead, having a total value of $80,680, as compared with $65,201 in 1919.

The principal producing mine was the Michigan-Uthoff, from which pyrite ore was sold to the General Chemical Co.'s sulphuric acid plant at Denver for its sulphur content, the roasted residues, containing silver and gold, being shipped to the Pueblo and Leadville smelters. Several hundred tons of oxidized ore carrying silver was shipped from the Silver Queen mine. A car of lead-silver ore was shipped from the Avalanche-Surprise group by the Four-Most Co.

Montezuma district.—The Montezuma district produced only 1,092 tons, principally dump ores from the Pennsylvania mine and treated experimentally in the 100-ton gravity-concentration and oil-flotation mill on the property.

TELLER COUNTY.

Crude ore and dump ore, slags, slimes, and stolen bullion in 1920 from the Cripple Creek district, aggregated in recovered gold to United States mints and to smelters, 209,173.40 fine ounces, valued at $4,323,998.

The Golden Cycle mill, at Colorado Springs, a roast-cyanide plant (with subsidiary amalgamation) of 1,200 tons daily capacity, was operated steadily at about three-fourths capacity. The Portland roast-cyanide concentration mill at Colorado Springs remained idle and was dismantled.

In the Cripple Creek district the Portland Co.'s Independence 1,400-ton daily capacity cyanidation-concentration mill was operated steadily on low-grade company and custom ore, with the addition of some company ores of higher grade.

In Poverty Gulch no mines were productive.

On Tenderfoot Hill one shipment was made from the Queen Bess mine.

On Globe Hill lessees on the Stratton estate mines shipped from the Deerhorn.

On the north slope of Ironclad Hill the producing mines were the Damon, Forest Queen, Jerry Johnson, and W. P. H. The Lincoln Mines & Reduction Co. continued experimentation at its new mill and operated the old Rex cyanide mill for some time.

On Gold Hill the El Paso Extension Gold Mines Corporation shipped throughout the year from the Index mine. On Raven and Guyot hills the producing mines were the Cresson, Doctor-Jack Pot, Elkton, Jo Dandy, and Mary McKinney. Shipments were also continued from the Economic dump. The Cresson continued to be one of the principal producing mines in the district.

On Beason Hill the producing mines were the El Paso and Prince Albert.

On Bull Hill the producing mines were the Blue Bird (Buckeye), Dante, Dexter, Gold Sovereign, Last Dollar, Modoc, Stratton Estate mines (American Eagles, Logan, Longfellow, Six Points, and others), and the United Gold Mines Co. group.

Between Altman and Goldfield the producing mines were the Acacia (Burns), Findley, Golden Cycle, Isabella, Victor, and Vindicator. The Vindicator Consolidated Gold Mining Co., in its annual report for 1920, says:

> The total development for the year amounted to 5,306.0 feet, of which 1,161 feet were driven by lessees.
>
> The developing work during the past year was seriously handicapped owing to acute labor shortage. What men could be obtained were concentrated, so far as possible, in demonstrating the possibilities of the new Lillie vein system which was first opened up on the nineteenth level of the Vindicator shaft, the length on this level being in the aggregate 300 feet. However, on stoping it was found that the values on the north end disappeared at a distance above the level of about 55 feet. Further development in this stope indicated that this ore occurrence was a deposit, making commercial ore for a limited extent vertically on top of a comparatively flat phonolite dyke, the ore shoot rising at a low angle to the south toward the surface, which made its location on the eighteenth level considerably farther southeast than was at first anticipated. In August, what we believe is this ore shoot was opened on the eighteenth level for a length of about 100 feet. The ore on this level is apparently cut off on

its southern extension by a basalt dyke crossing the vein. If this proves to be a fact, we will be justified in assuming that we have proven the extent of this ore shoot, that it is limited, and can not be expected to extend to the sixteenth level.

Although the Portland Co. is pumping and holding the water level in their property at about 210 feet below the water level in the Vindicator, there has been no appreciable diminution in the amount of water it has been necessary to handle at our property, which averages 300 gallons per minute.

During the year 26,438 tons of crude ore were hoisted on company account, from which were produced 3,524 tons of shipping product, with a gross value of $158,899, the marketing charges on which were $25,536 and the net returns $133,363.

There were hoisted on lessees' account 47,978 tons, and shipments from this source totaled 18,199 tons, with a gross value of $268,874, marketing charges on which were $74,177, leaving a net value of $194,697. The company's royalties on lessees' shipment amounts to $98,087.

On Battle Mountain the producing mines were the Granite, Portland-Independence group, Rose Nicol, and Strong. The annual report of the Portland Gold Mining Co. for 1920, dated February 21, 1921, says:

The decision on December 6 last, to discontinue the payment of dividends by the company, was not due to the exhaustion of either the high or low grade ore bodies in your mines, nor was it due to lack of capacity in your Independence mill to treat low-grade ores at a profit under normal conditions.

The shortage of labor resulting from the war was very acute in the Cripple Creek district in the years 1917, 1918, 1919, and 1920. This shortage limited our mining operations almost wholly to the mining of ores from the ore bodies already developed. It limited our ability to block out or develop additional ore bodies, and it seriously interfered with the mining and transportation to the Independence mill of a sufficient tonnage to enable that mill to operate to full capacity.

Our present hoist is capable of economic work to a depth of only 2,500 feet. Inasmuch as we expect later to sink the shaft to a greater depth, we availed ourselves of the opportunity to purchase at a very low price, an additional first-class steam hoist. This will be ready for use when needed and will enable us to operate our mine to a depth of 3,500 feet.

During the last months of the year labor became more abundant and we were able to secure additional skilled labor, and all the unskilled labor we needed, so that on January 1, 1921, we were able to start working the mine two shifts per day. The indications are that we will have an abundant labor supply during the remainder of the year.

For reasons already stated, curtailment of the development work in the mine commenceed as early as 1917. Connection of our lower-levels with the Roosevelt drainage tunnel was made about January 1, 1919, on our twenty-first level. Until this connection was made, it would have been wasteful to attempt to sink our working shaft or to open up new levels at this depth, hence we confined our development work to the levels opened in the mine prior to the drainage connection by the tunnel. This work produced a considerable quantity of high-grade ore and a much larger tonnage of low grade. Later the work in the twenty-first and twenty-third levels resulted in the opening up of our main ore bodies. It is from these levels that the greater part of our high-grade ores has come in the last year.

During the year 1920 one new high-grade ore shoot was developed on the 1,000-foot level. There is one good ore body which has not been developed below the 1,700-foot level, and another which has not been developed below the 1,800-foot level. These ore bodies have produced a good tonnage in the past and the company plans to develop them through the drainage tunnel, or twenty-first level.

Our main working shaft has now reached a depth of 2,477.65 feet. The working station for the new twenty-fourth level is located at a depth of 2,451.65 feet. This is 168 feet below our twenty-third level. In it station pumps capable of handling 2,000 gallons of water a minute are installed. The present flow of water is about 650 gallons to the minute. A crosscut from this station to our main vein opened 4 feet of high-grade ore on February 5. The vein

at this date shows a width of about 8 feet, screening samples of which give assay values of from $40 to $90 of gold per ton. The results thus far obtained indicate that we should secure just as good returns from this level as from the level above. Within a few months we should encounter two additional high-grade ore bodies in this level. It is our plan to develop these ore bodies on this level with all convenient speed, and later we will sink the main working shaft to a greater depth.

The Independence mill, which is a modern cyanide plant for the treatment of low-grade ores, was finished about July 1, 1917. The transportation equipment designed to transport the ores from our mines to this mill is very complete, and capable of transporting 2,600 tons of ore per day, even when operated on only one eight-hour shift.

During the last four months of 1917 we made a test run at this mill and treated an average of 37,500 tons per month. This test showed that at that time the mill could make a satisfactory profit by treating ore having a value not exceeding $2.00 per ton, and that it made a little better than an 80 per cent extraction of the gold contents of the ores. This test demonstrated conclusively the capacity of the mill to perform profitably the work for which it was designed and justified all the expenditures incurred in its construction.

Since that time other experiments, especially those of the last six months, have shown that this mill can treat satisfactorily all of our high-grade ores, excepting a very small portion of the richest ore. It is the company's intention hereafter to operate this mill in two units, one unit capable of treating at least 1,000 tons per day of low-grade ore, and the other, with a daily capacity of 200 tons, to treat the higher-grade ores.

On account of labor and other conditions resulting from the war, we have not been able to make the improvements needed to connect our low-grade ore bodies with our transportation system so as to deliver at the mill a sufficient tonnage to run it at its full capacity. The result has been that the mill obtained and treated only an average of 18,566 tons per month during the last year, whereas it was designed and has a capacity to treat 37,500 tons per month. This condition resulted necessarily in a loss of the mining and milling profits that would have been obtained had the mill been able to run at anything approximating its full capacity.

Before we built the mill our engineers estimated we had in sight about 14,300,000 tons of low-grade milling ores. However, we have found that these ores contained a considerable amount of waste rocks that under present conditions cannot be put through the mill at a profit. These ores can be sorted mechanically at a nominal cost. The great increase in the cost of all mining and milling operations resulting from war conditions makes the treatment of $2.00 ore no longer profitable. To increase the value of the ores put through the mill we have built at the Independence mine an ore-screening plant, which rejects about 50 per cent of the material passing over it and thereby increases the value of the ore saved about 50 per cent. If all our low-grade ores are handled in this manner, we believe we have in sight a sufficient tonnage to operate the mill for at least fifteen years, when treating about a thousand tons per day. We therefore decided last September to build an additional screening plant at our No. 2 shaft. This plant, together with one new loading chute for low-grade ore at our 1,800-foot level, will be completed about March 15 next. A new crosscut tunnel, a storage pocket, and additional loading chutes will be placed in commission, at which time we will be in position to deliver ample tonnage to run the mill at full capacity with low-grade ore from the old stopes adjacent to our No. 2 shaft.

The opening up of ore bodies on our twenty-fourth level and the completion of the mine and mill improvements above mentioned, together with an increase in the labor supply and a tendency toward lower costs for material and supplies, ought, we believe, to enable the company during the coming year to approach more nearly normal operating conditions.

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